US007901382B2

(12) **United States Patent**
Daily et al.

(10) **Patent No.: US 7,901,382 B2**
(45) **Date of Patent: Mar. 8, 2011**

(54) **AUTOMATIC NEEDLE DEVICE**

(75) Inventors: **David Daily**, Herzliya (IL); **Lior Raday**, D. N. Hof Ashkelon (IL)

(73) Assignee: **Dali Medical Devices, Ltd.**, Rishon Le Zion (IL)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1135 days.

(21) Appl. No.: **10/572,215**

(22) PCT Filed: **Sep. 15, 2004**

(86) PCT No.: **PCT/IL2004/000852**

§ 371 (c)(1),
(2), (4) Date: **Sep. 8, 2006**

(87) PCT Pub. No.: **WO2005/025637**

PCT Pub. Date: **Mar. 24, 2005**

(65) **Prior Publication Data**

US 2007/0118081 A1 May 24, 2007

(30) **Foreign Application Priority Data**

Sep. 17, 2003 (IL) 157984

(51) **Int. Cl.**
A61M 5/00 (2006.01)

(52) **U.S. Cl.** **604/187**; 604/137

(58) **Field of Classification Search** 604/187, 604/137, 131, 156

See application file for complete search history.

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Primary Examiner — Kevin C Sirmons
Assistant Examiner — Deanna K Hall
(74) *Attorney, Agent, or Firm* — Fish & Richardson P.C.

(57) **ABSTRACT**

An automatic needle device including a housing element, at least one resilient element arranged to be located within the housing element, at least one needle bearing element adapted, when actuated, to be displaced by the at least one resilient element with respect to the housing element from a non-penetration position to a penetration position and a needle guard adapted for positioning with respect to the housing element and wherein displacement of the needle guard is operative to actuate displacement of the at least one needle bearing element from the non-penetration position to the penetration position.

40 Claims, 82 Drawing Sheets

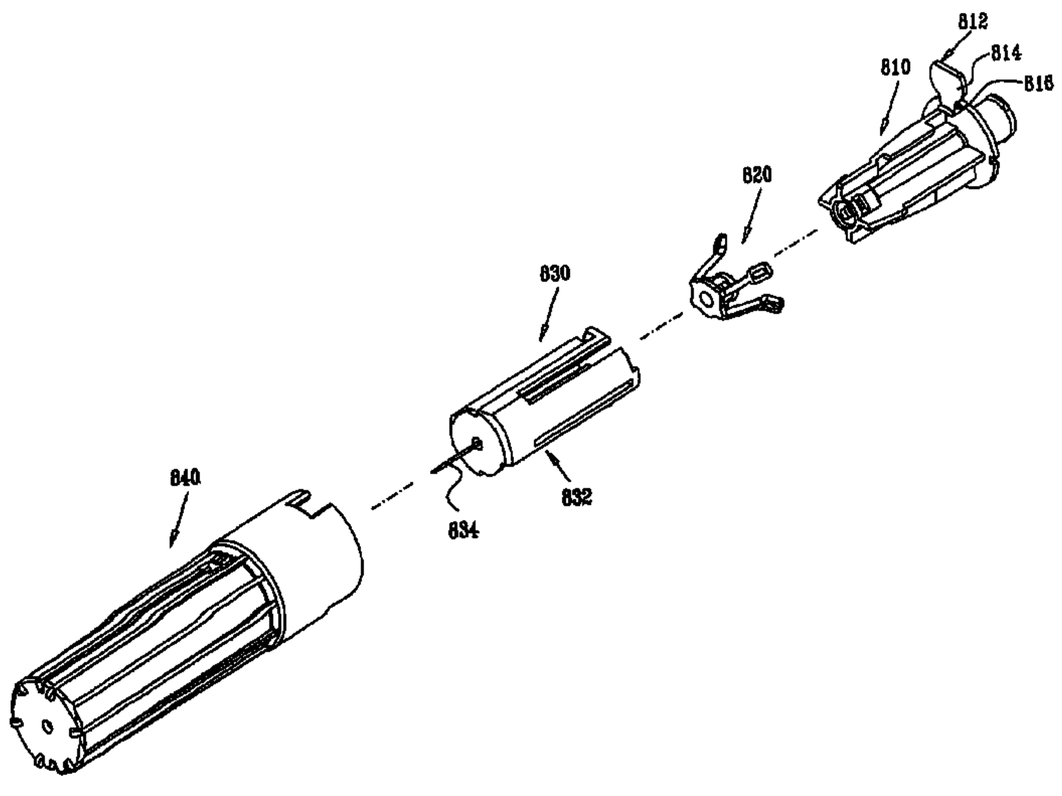

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FIG. 1

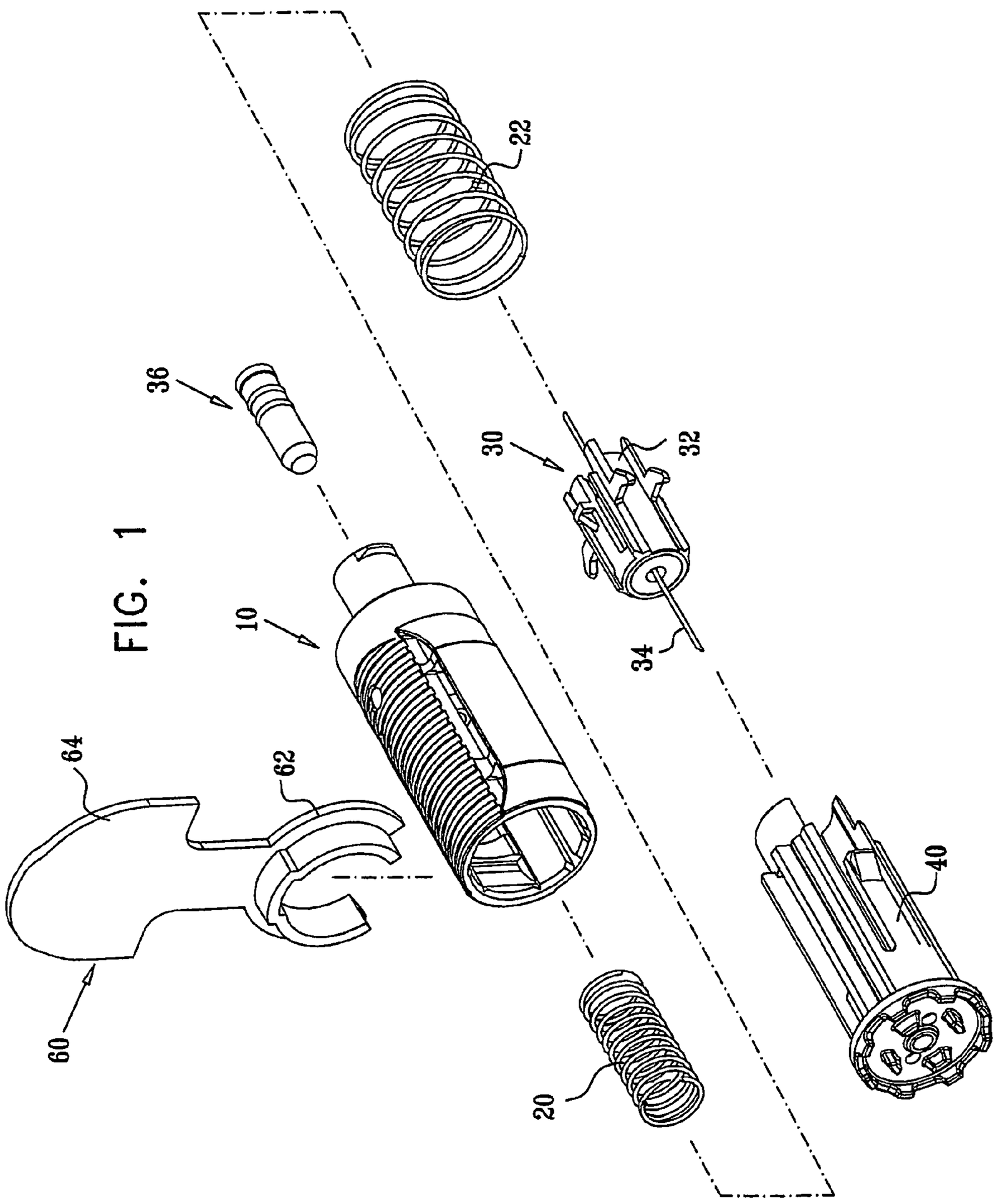

FIG. 2A

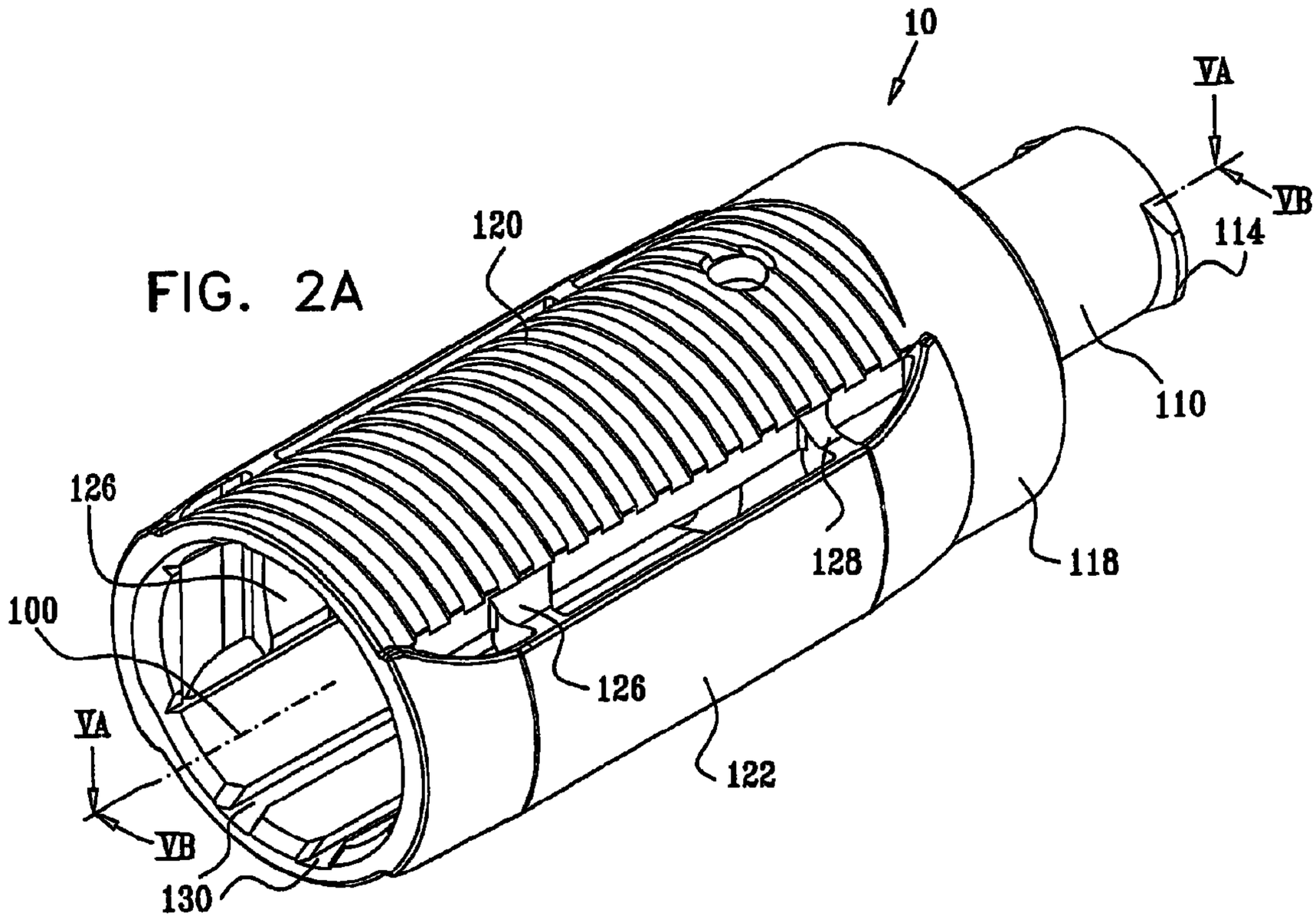
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FIG. 2B

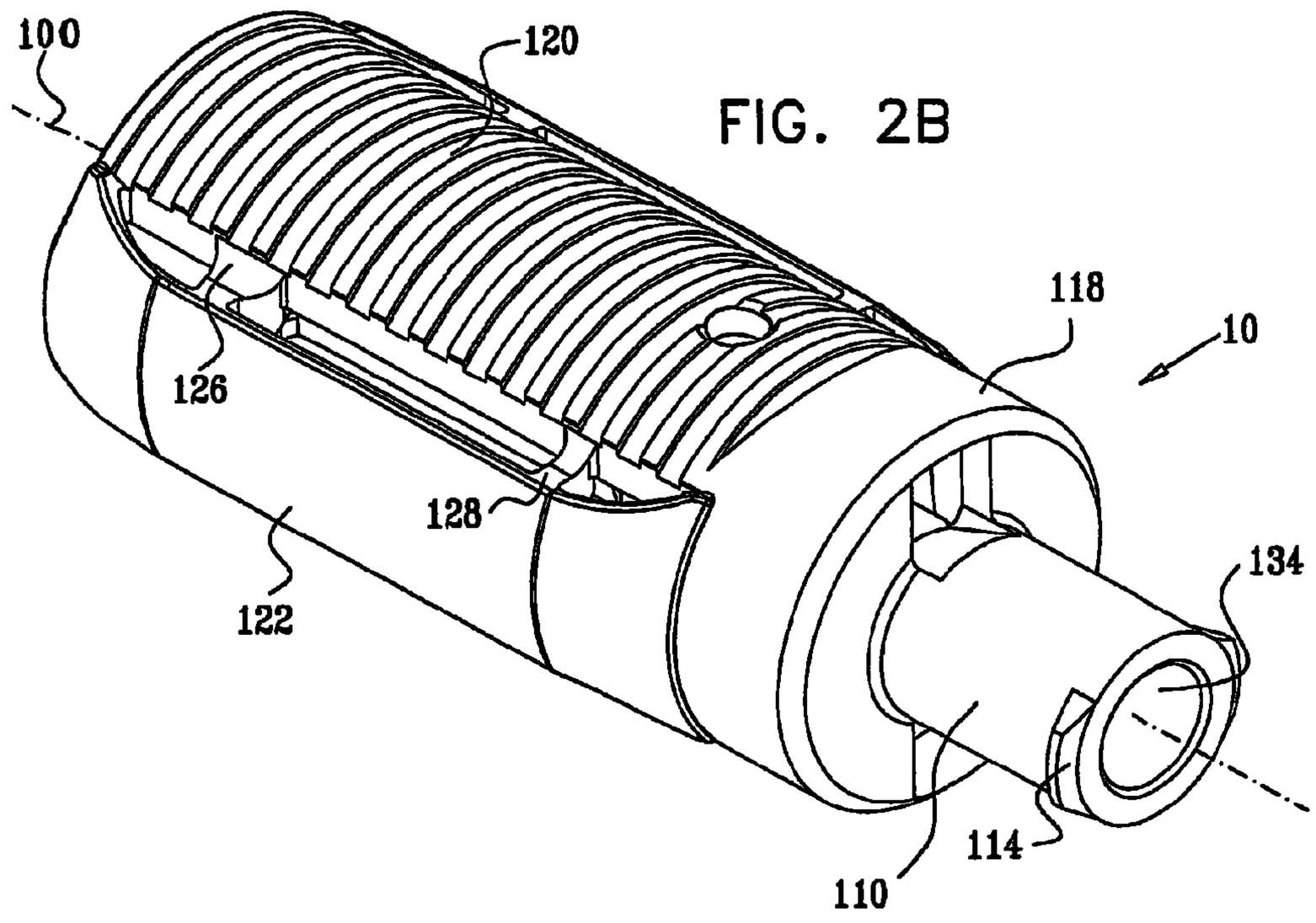
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FIG. 3A

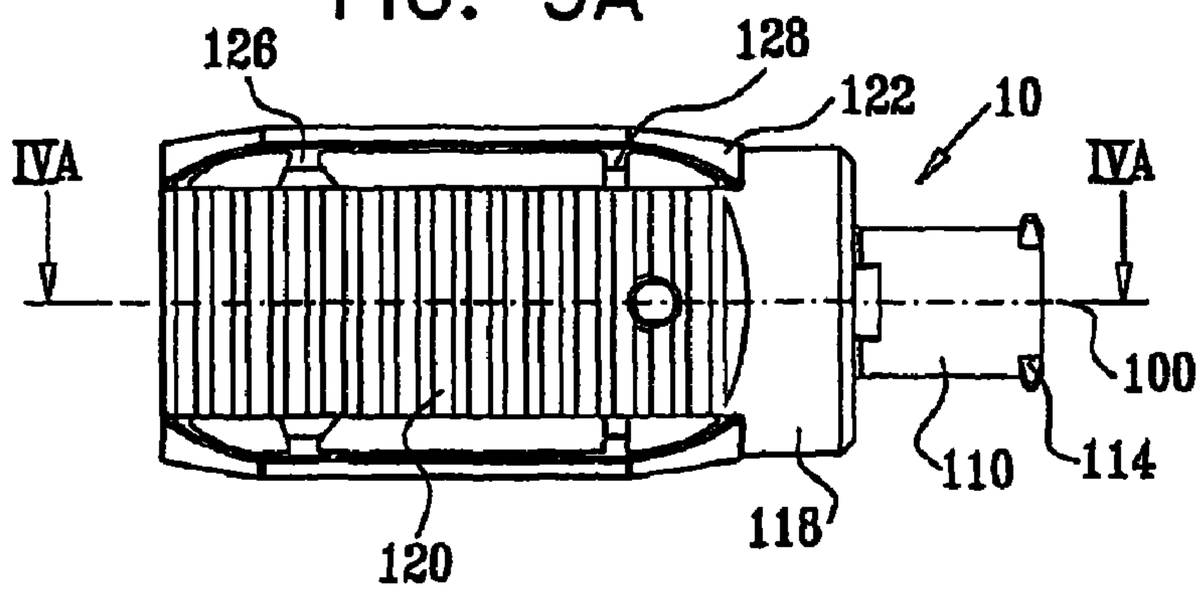

FIG. 3B

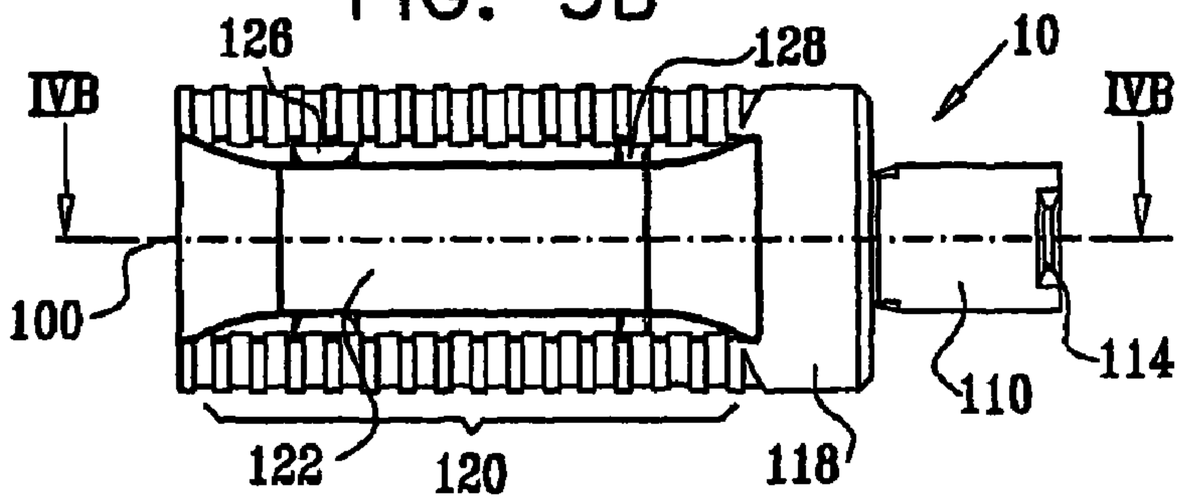

FIG. 4A

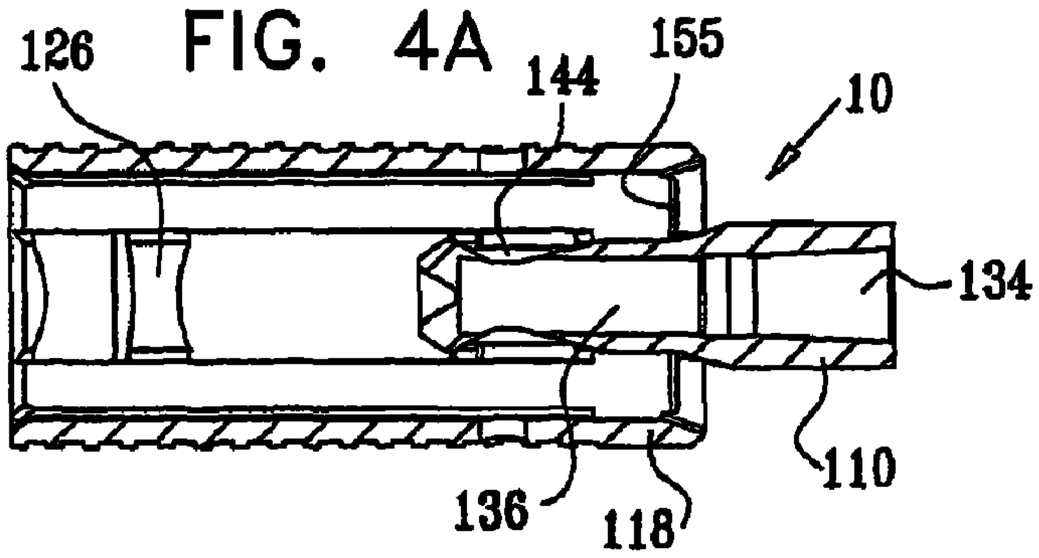

FIG. 4B

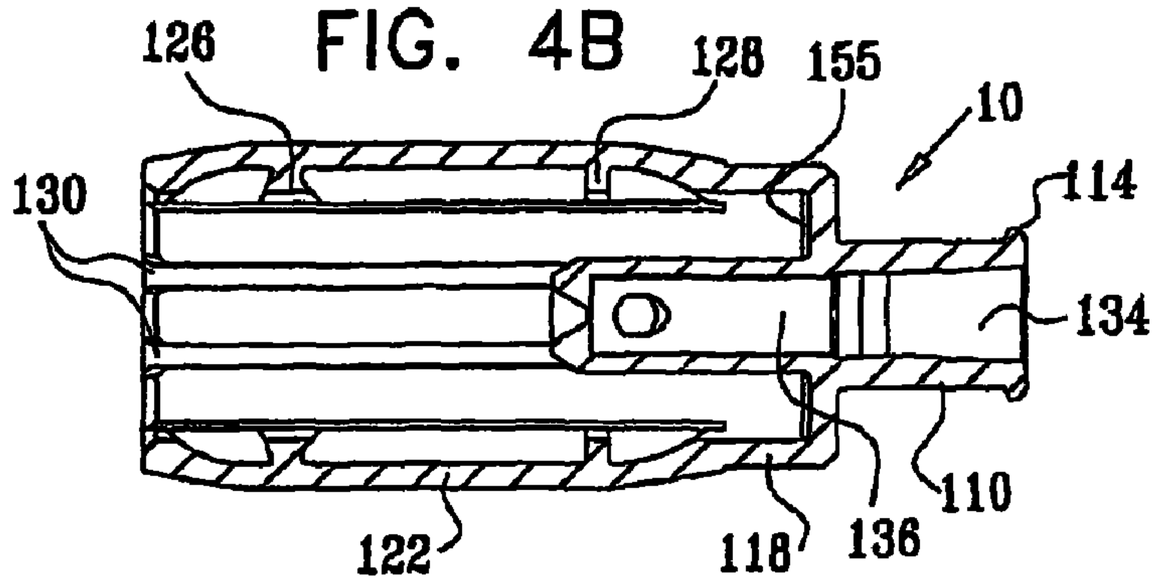

FIG. 5A

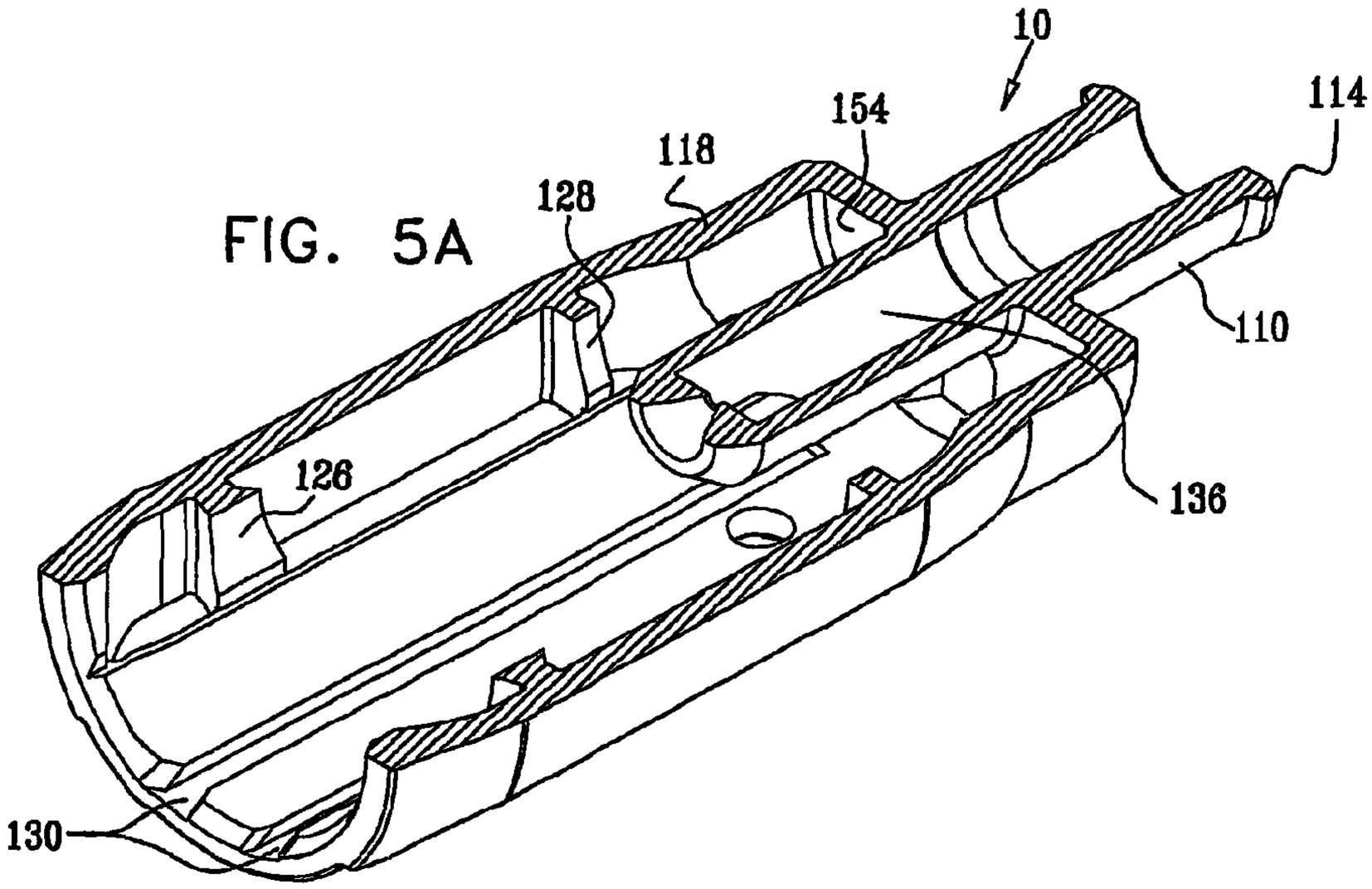
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FIG. 5B

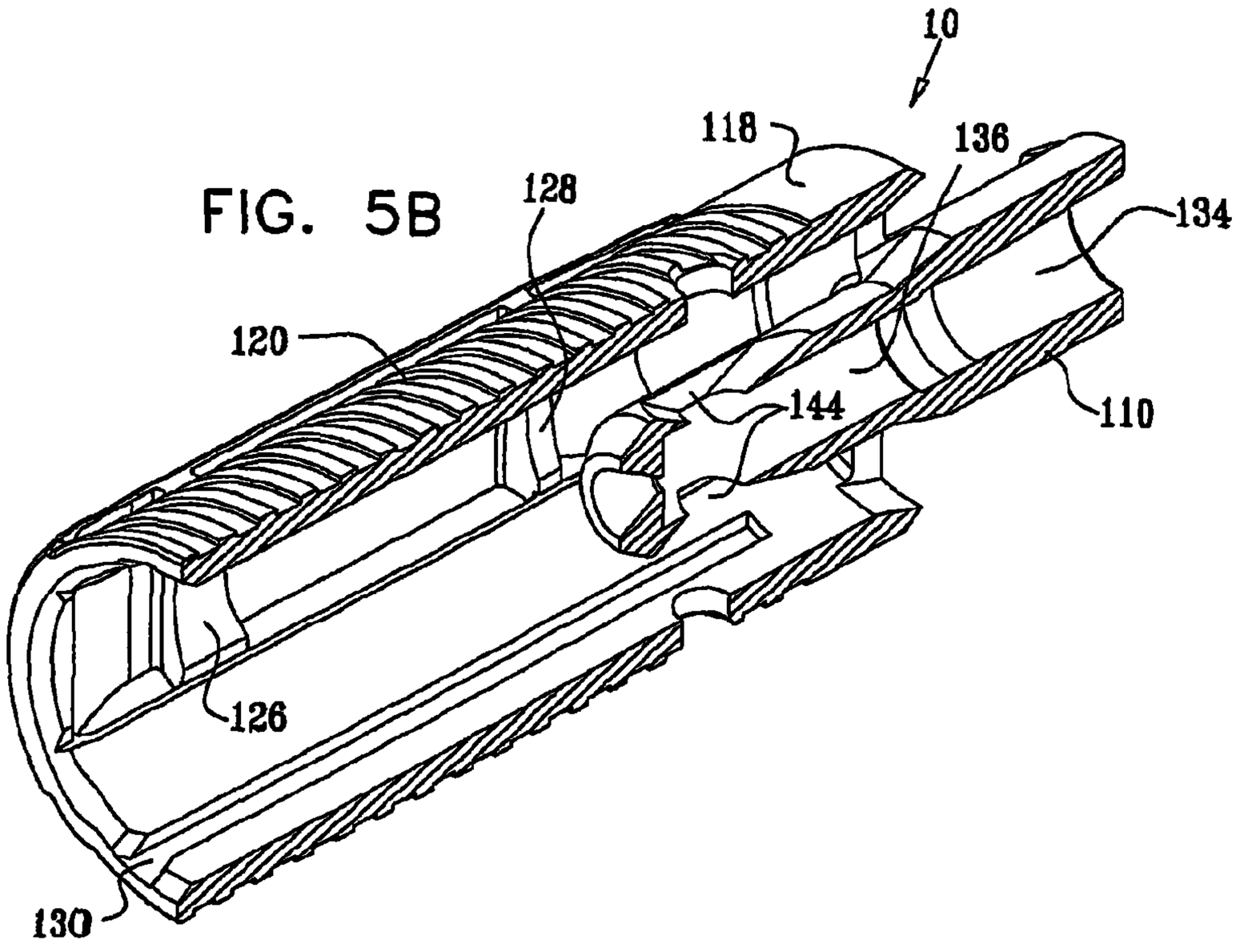
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FIG. 6A

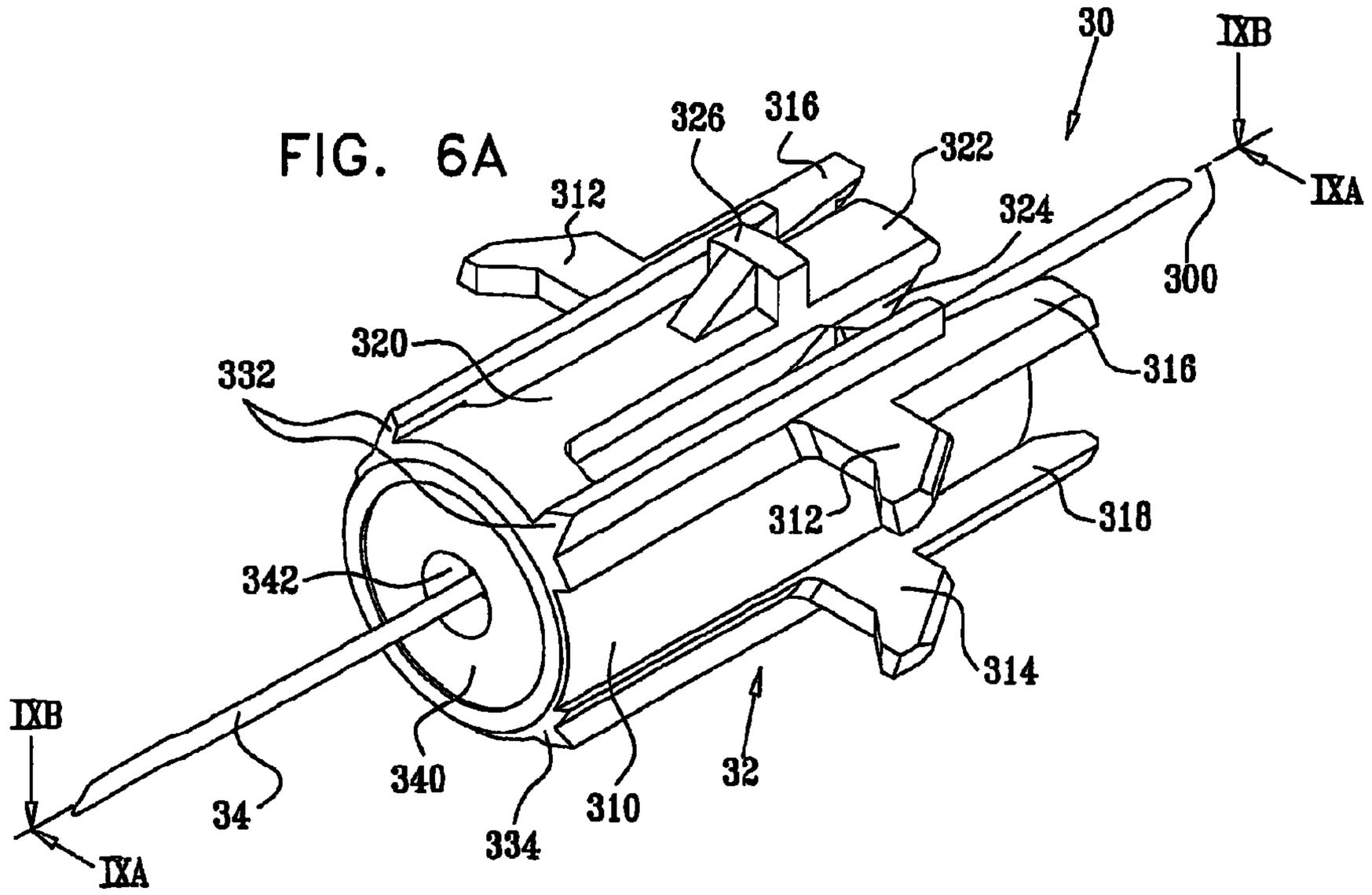
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FIG. 6B

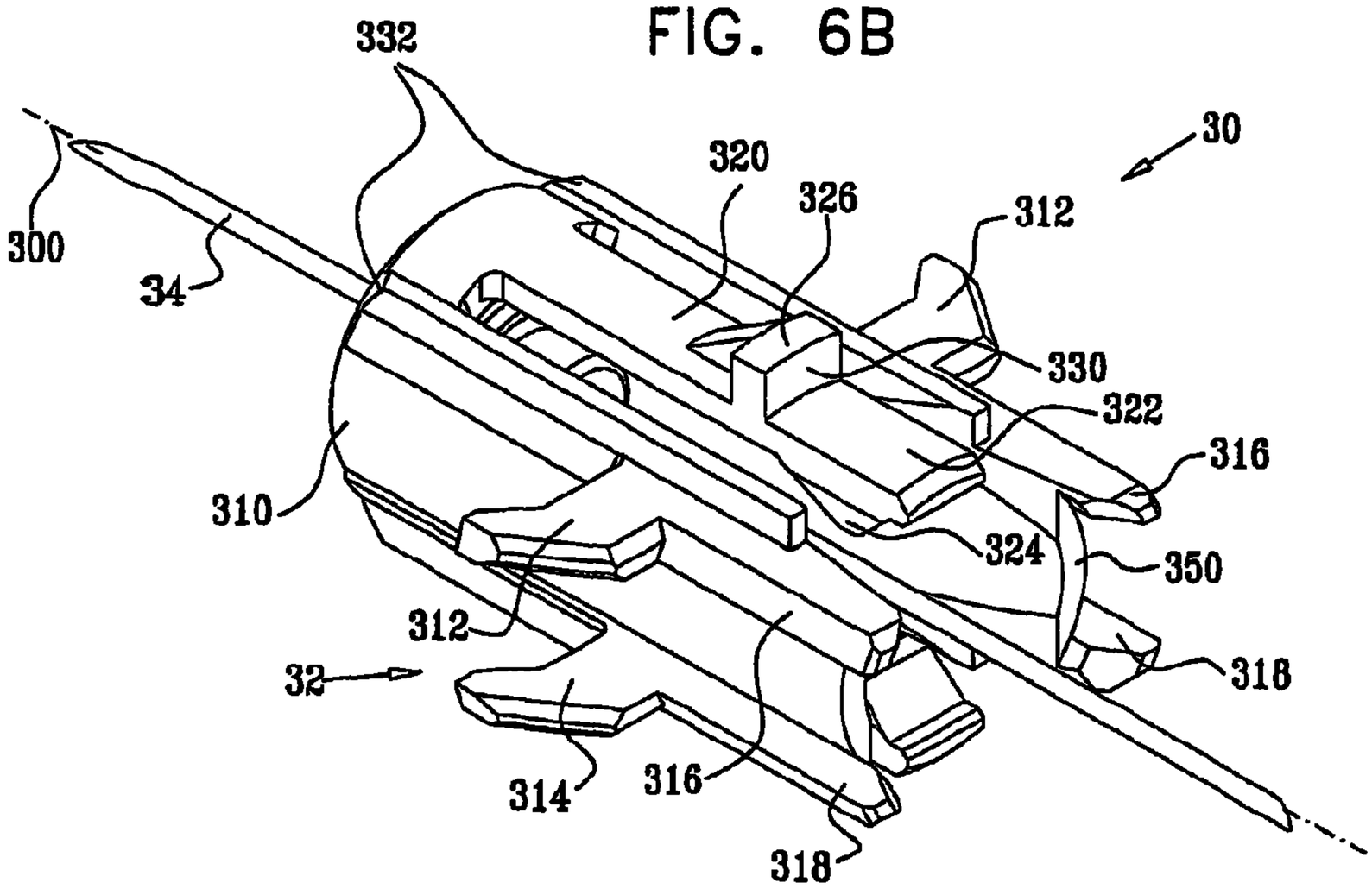
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FIG. 7A

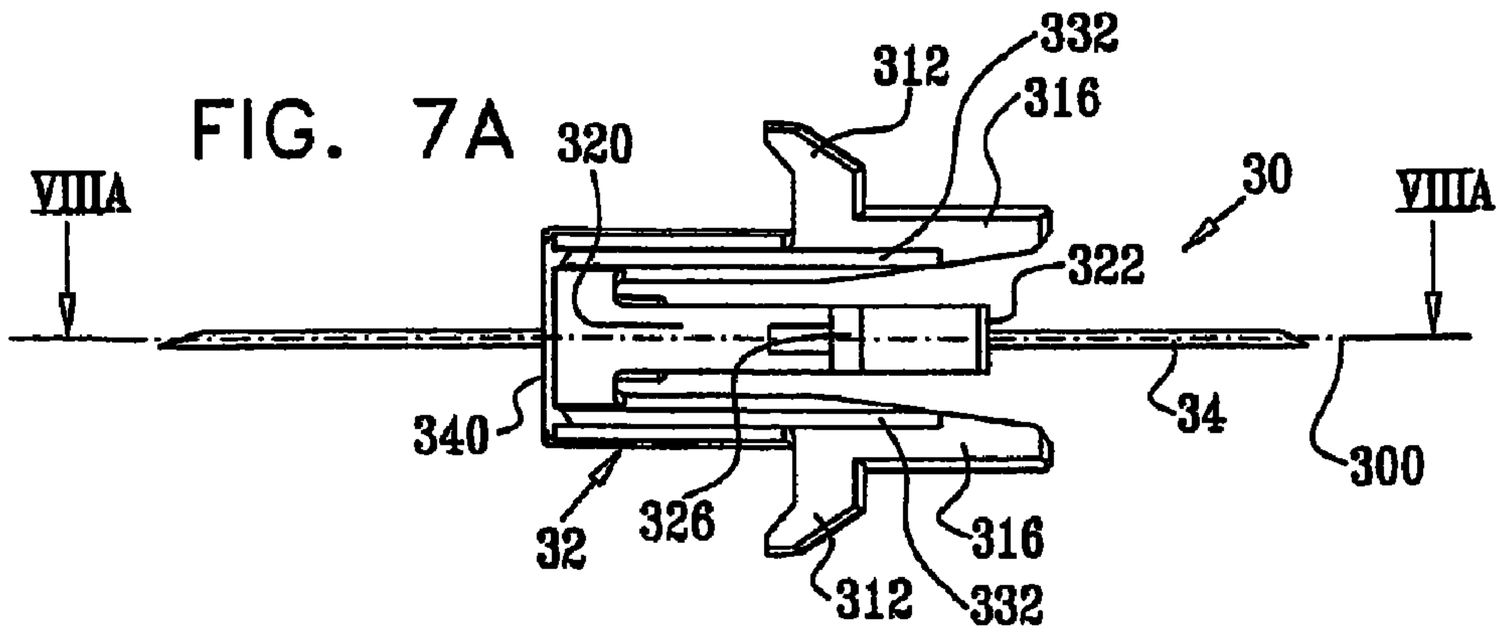

FIG. 7B

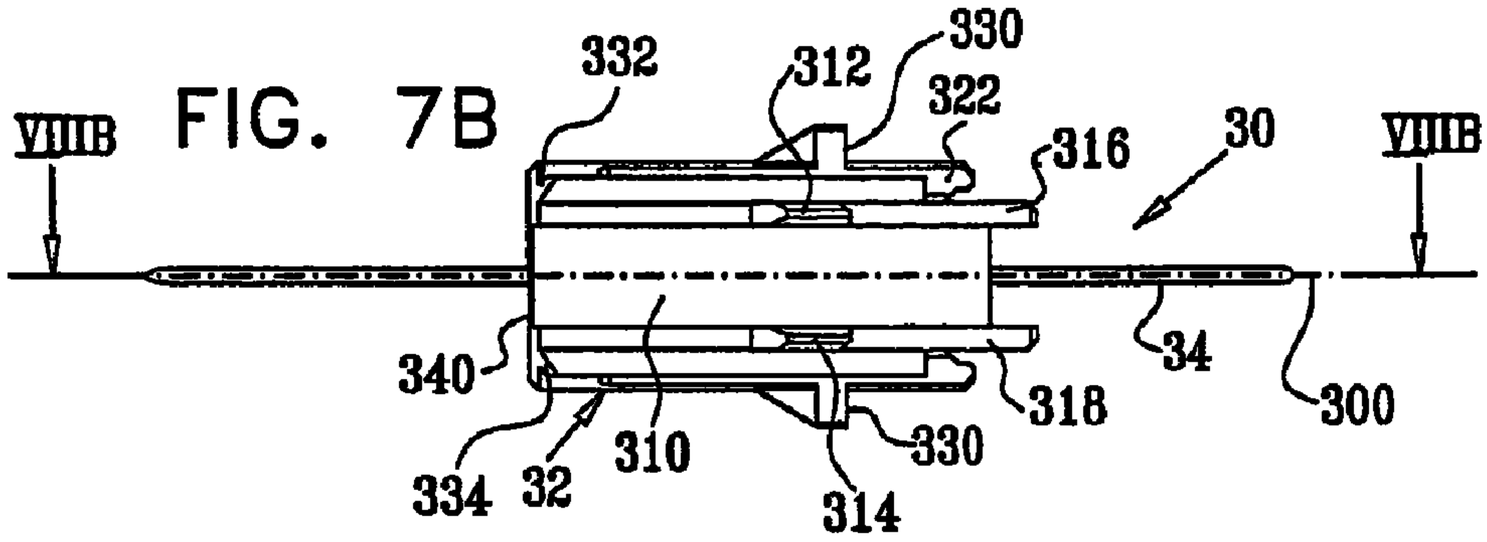

FIG.8A

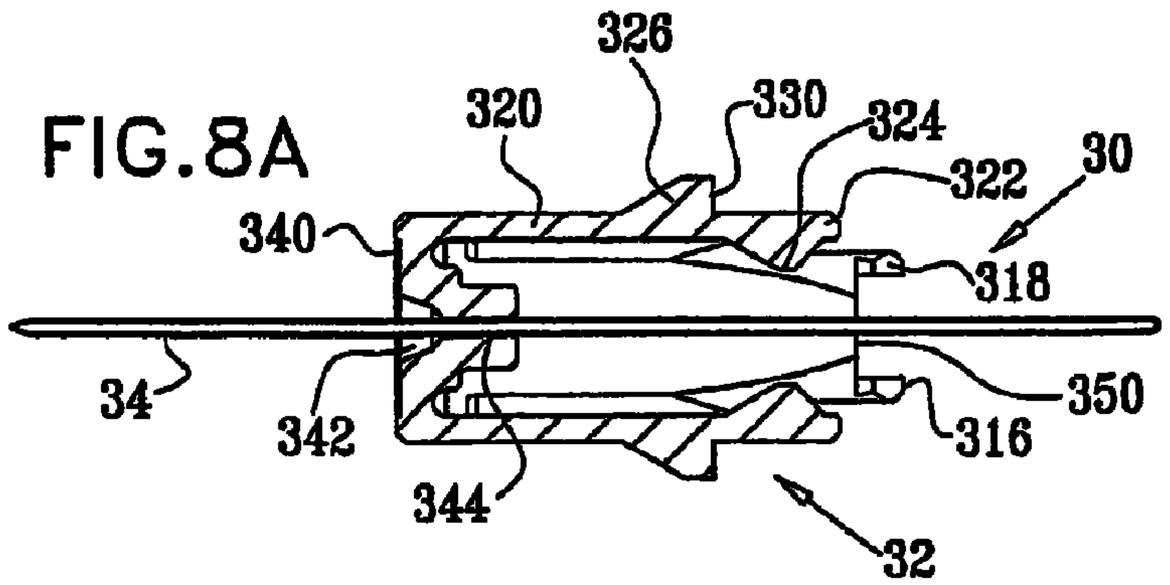

FIG. 8B

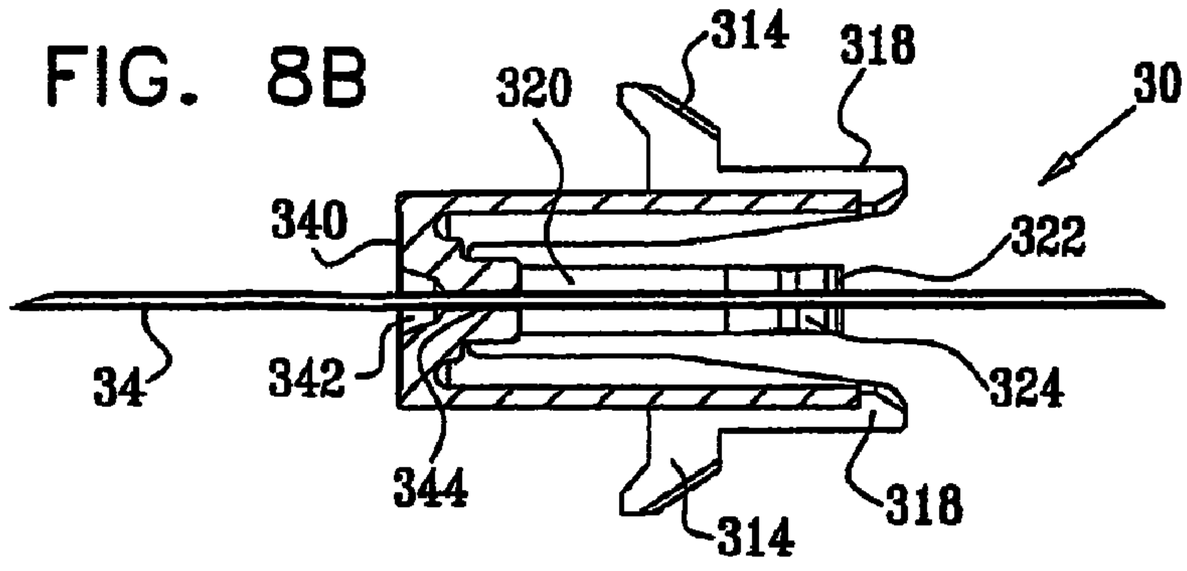

FIG. 9A

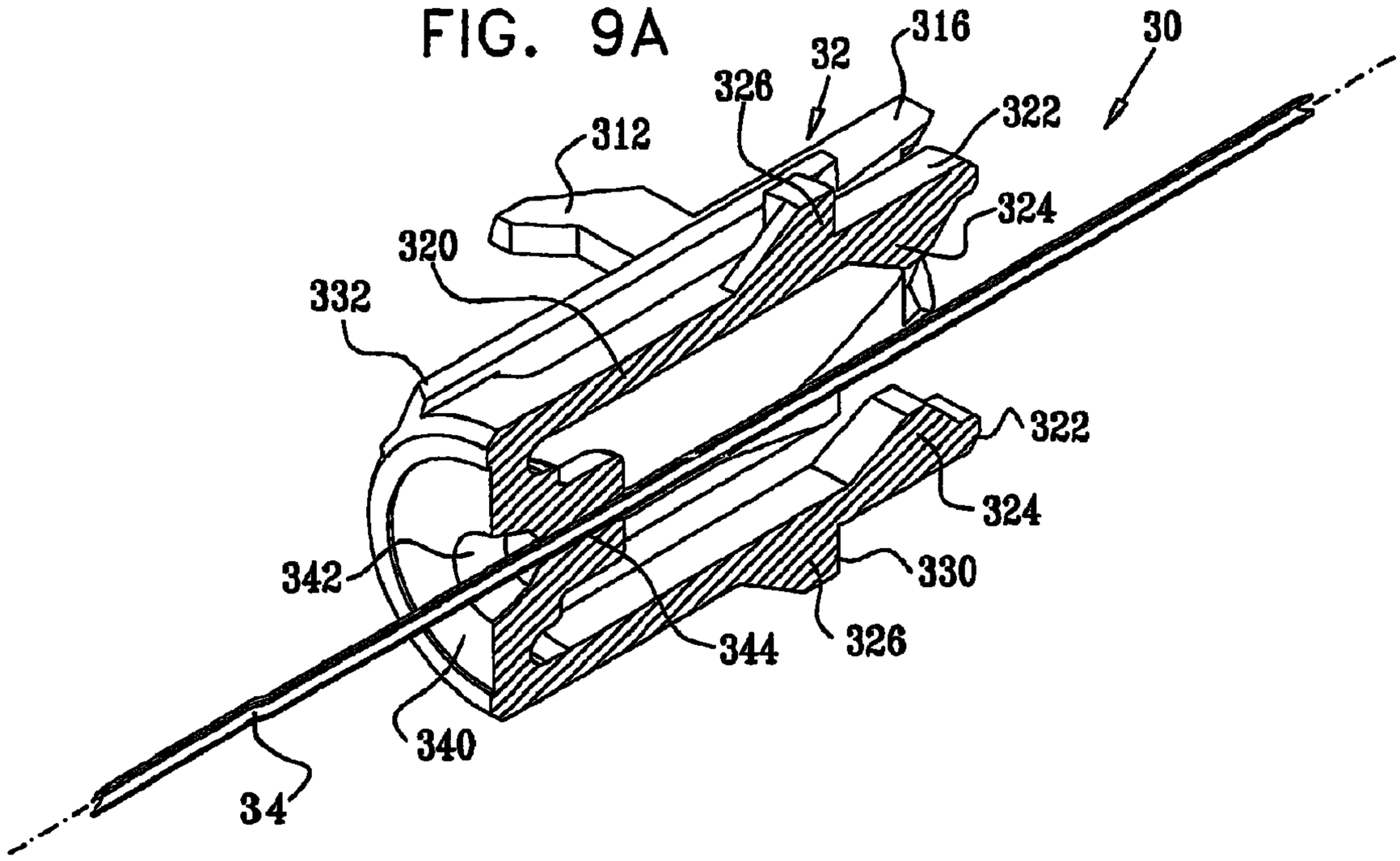
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FIG. 9B

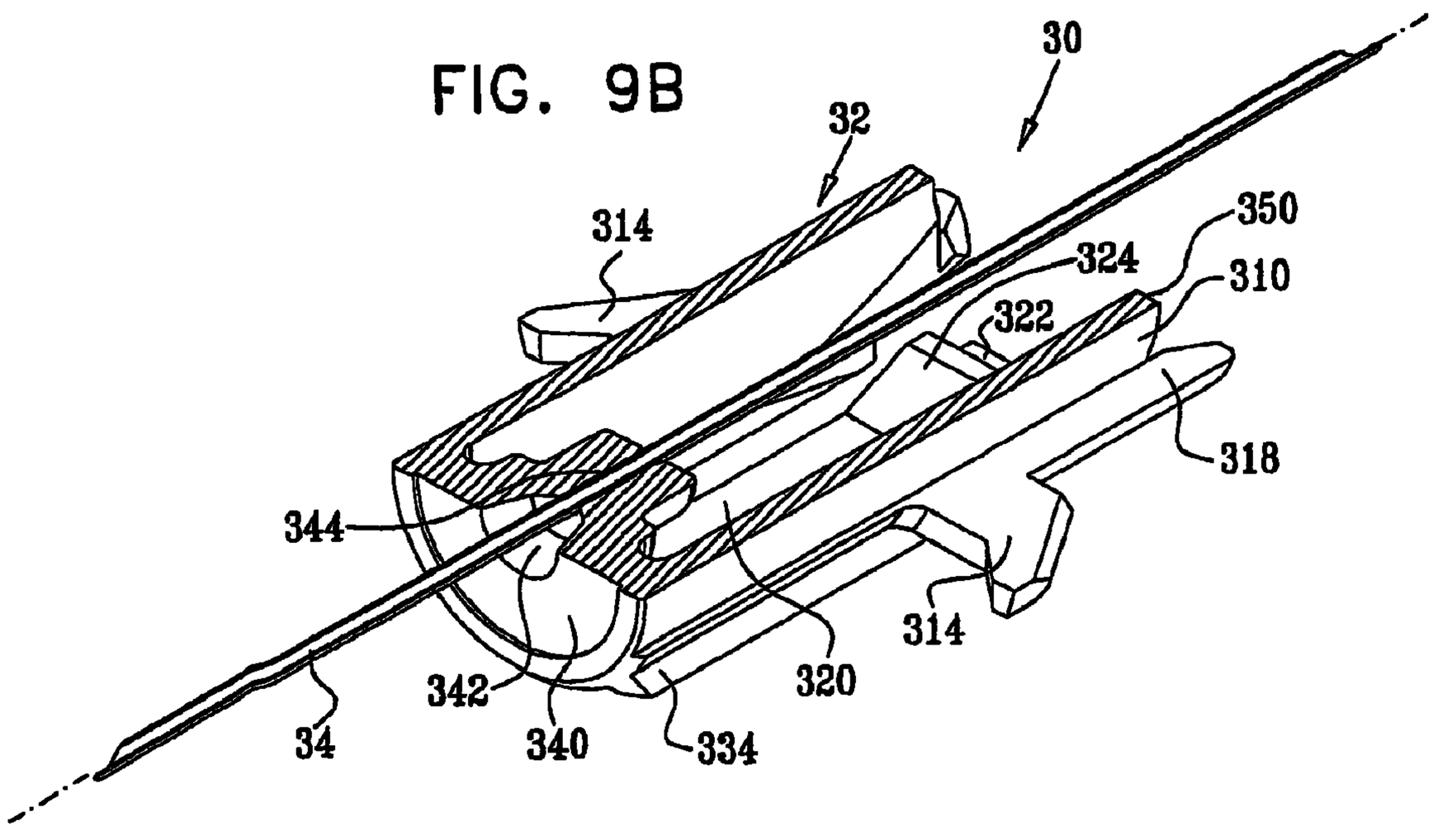
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FIG. 10A

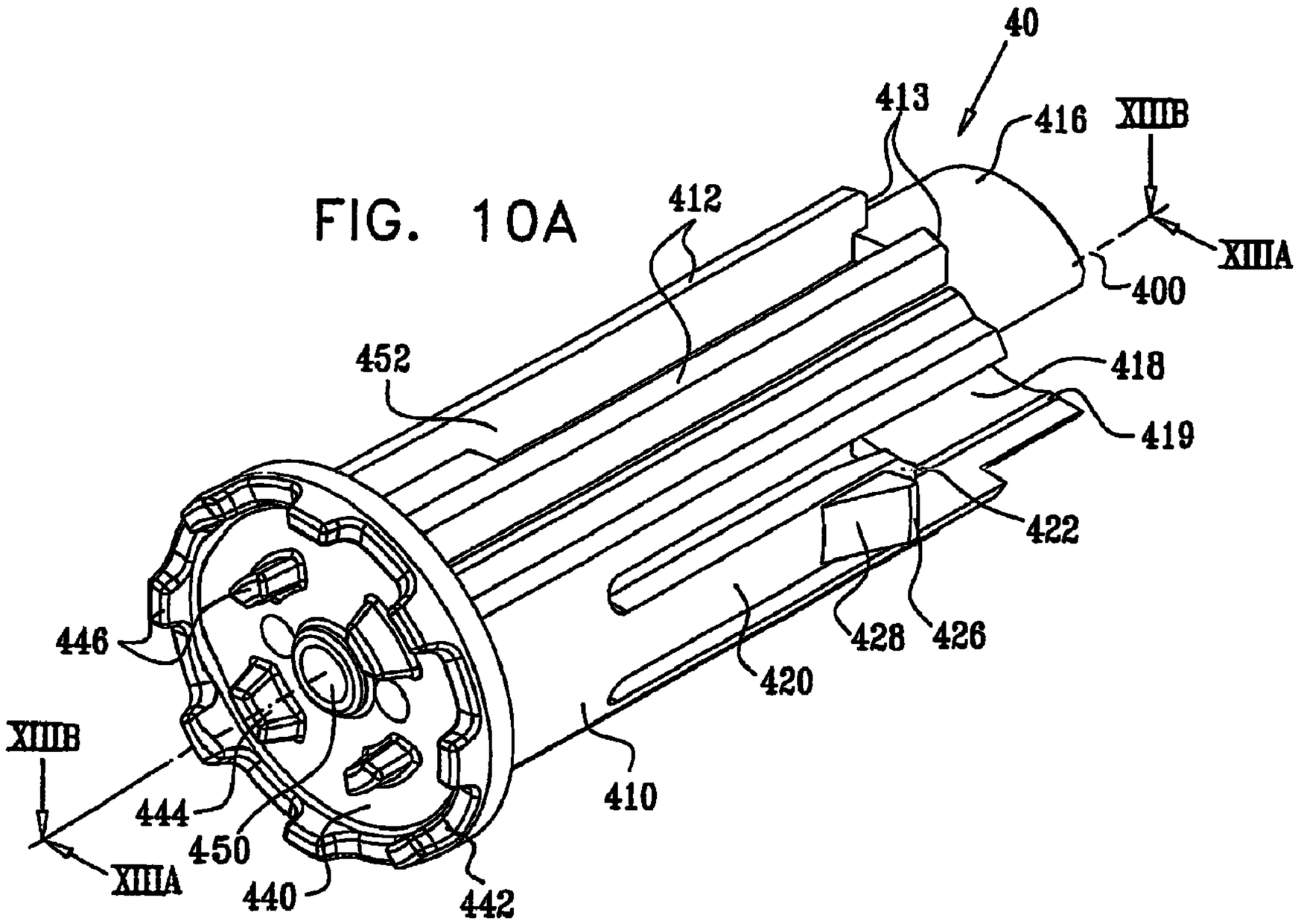


FIG. 10B

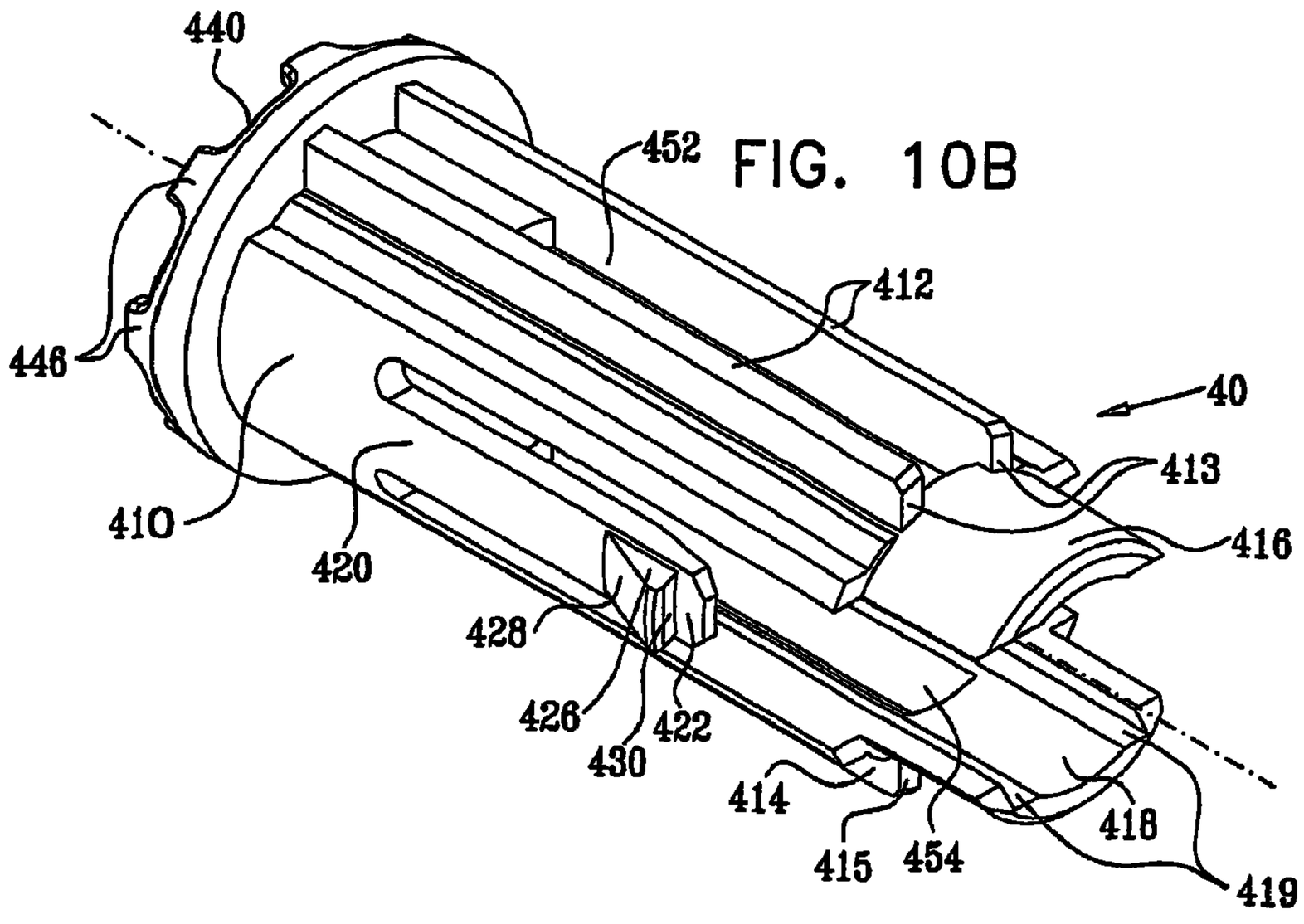


FIG. 11A

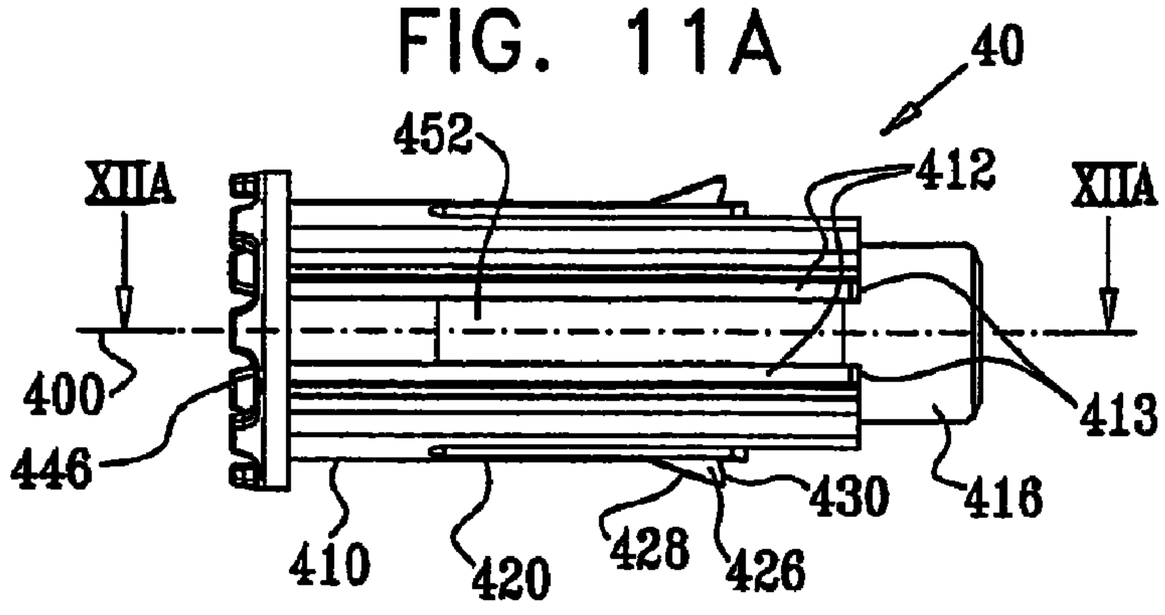


FIG. 11B

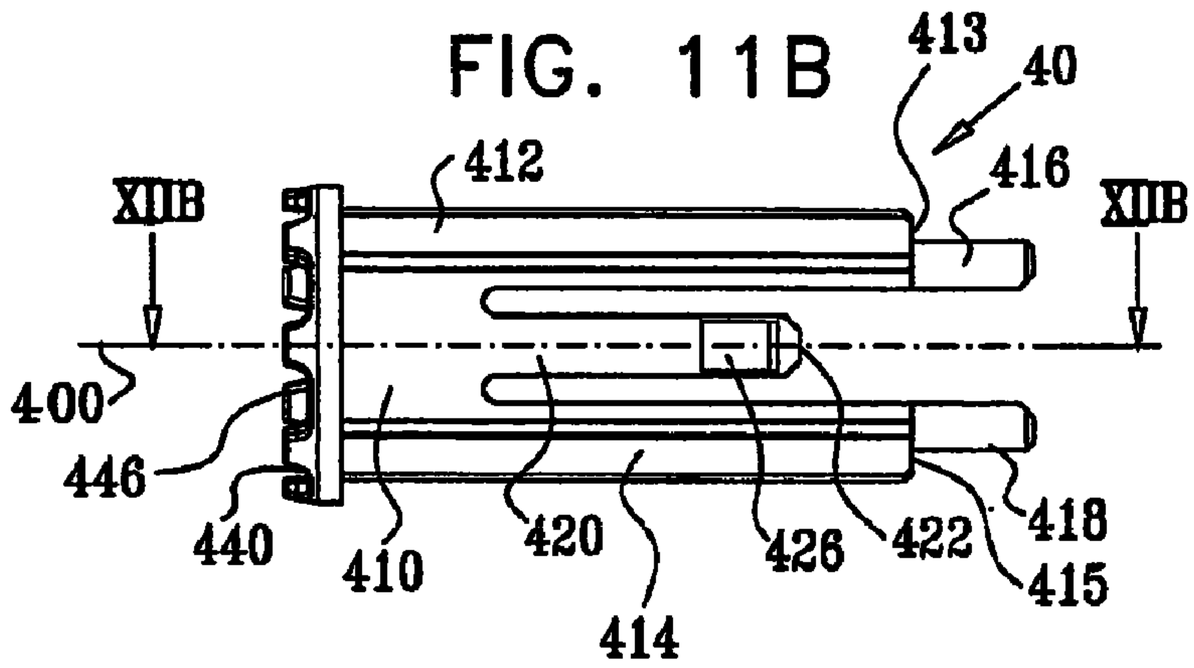


FIG. 12A

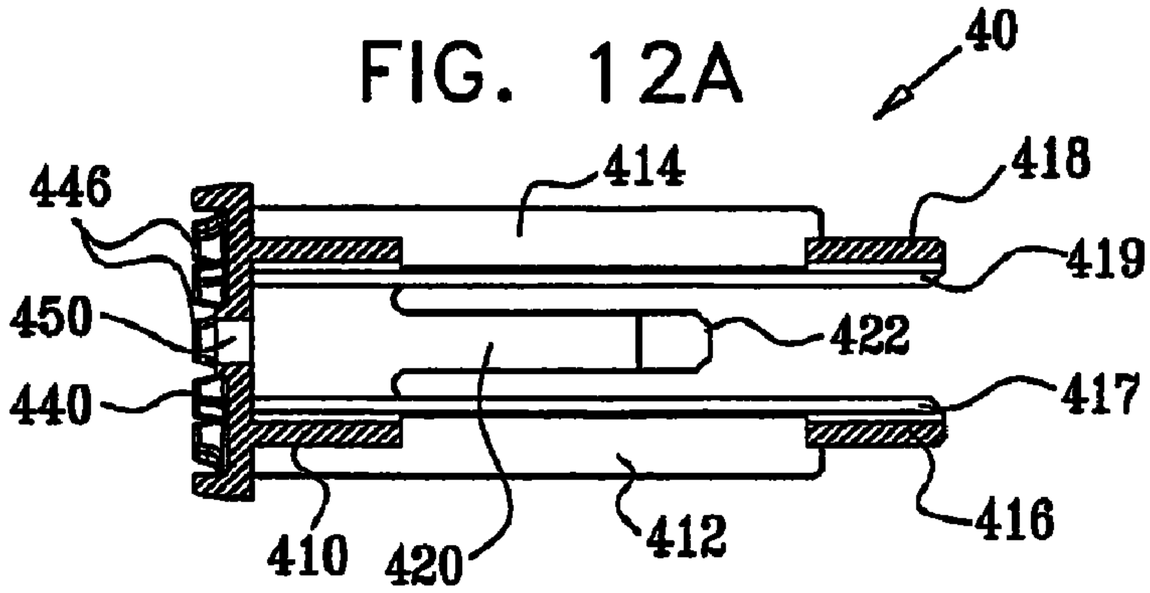


FIG. 12B

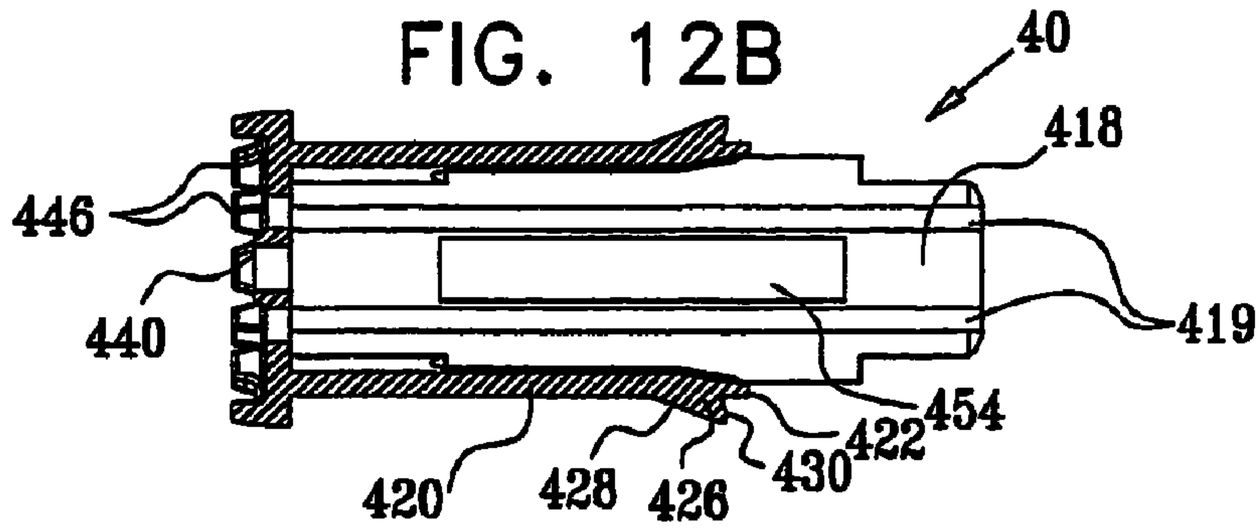


FIG. 13A

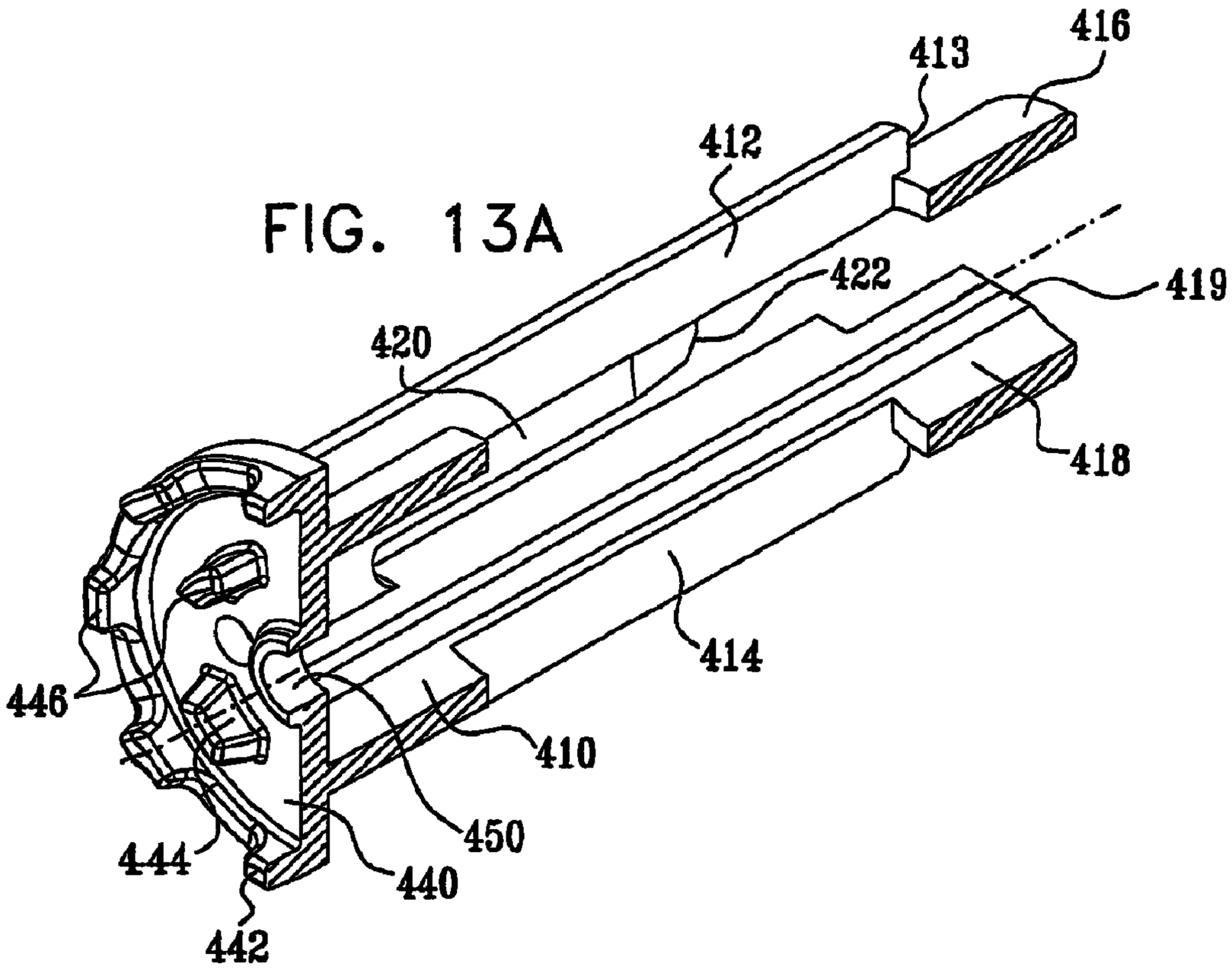
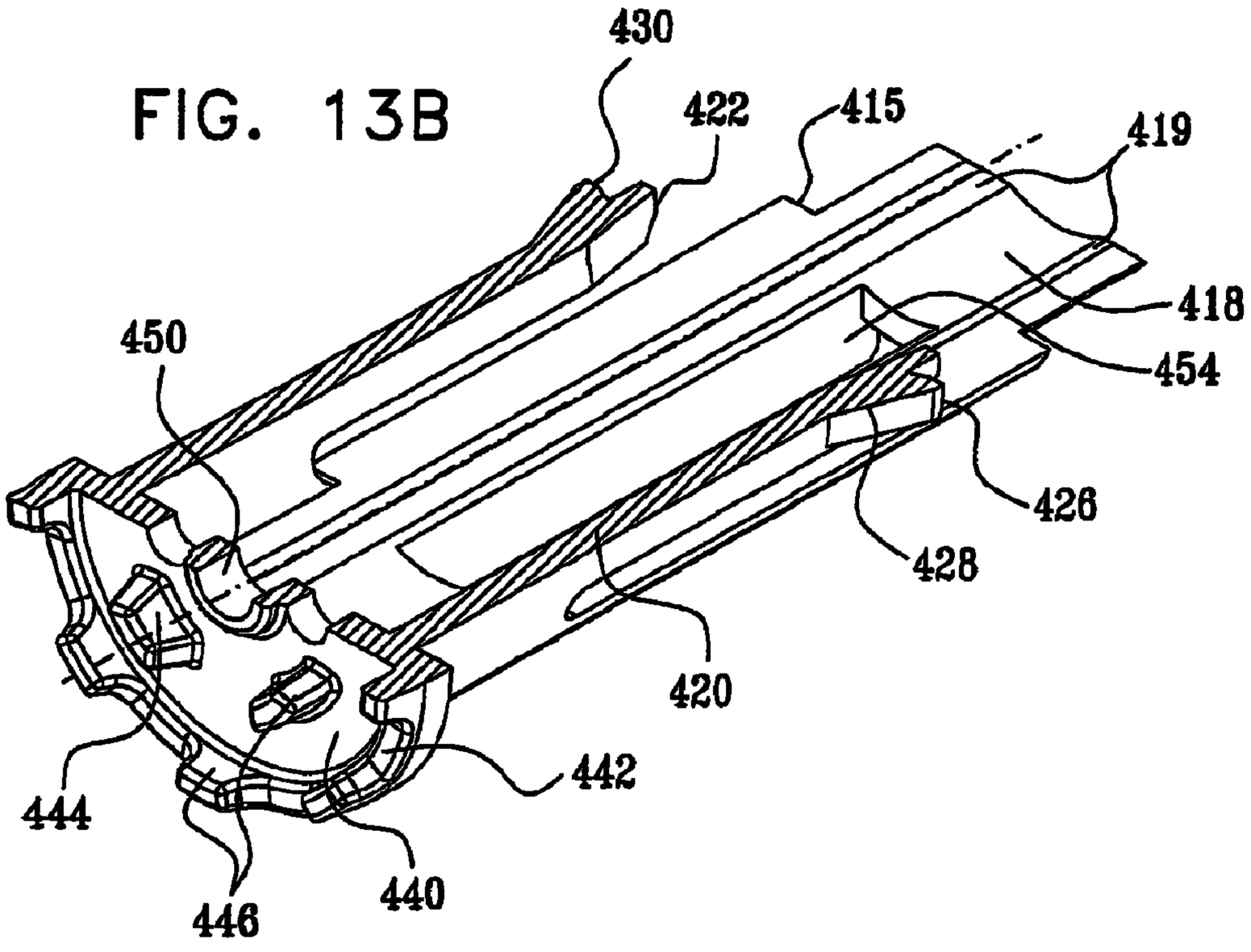


FIG. 13B



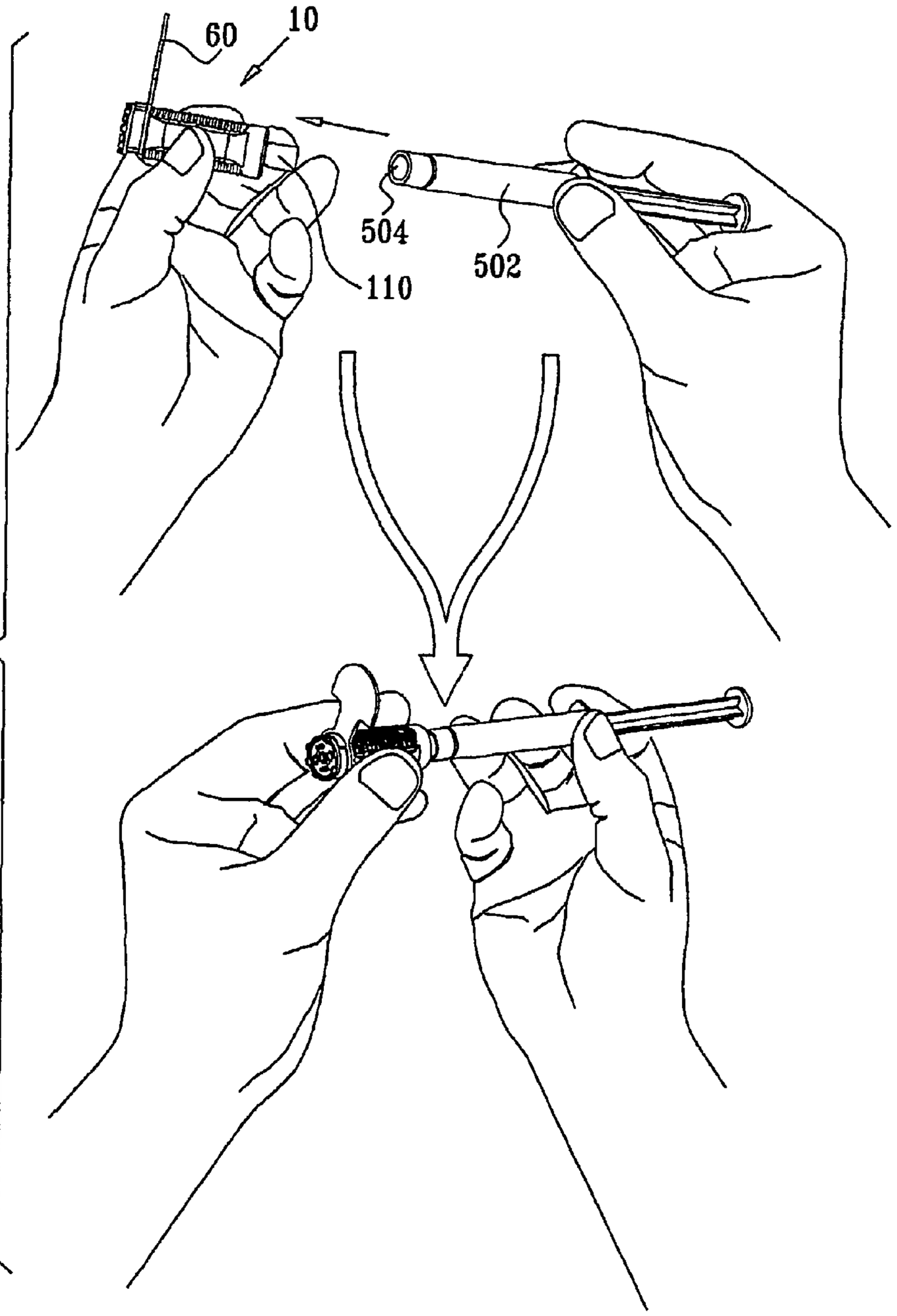
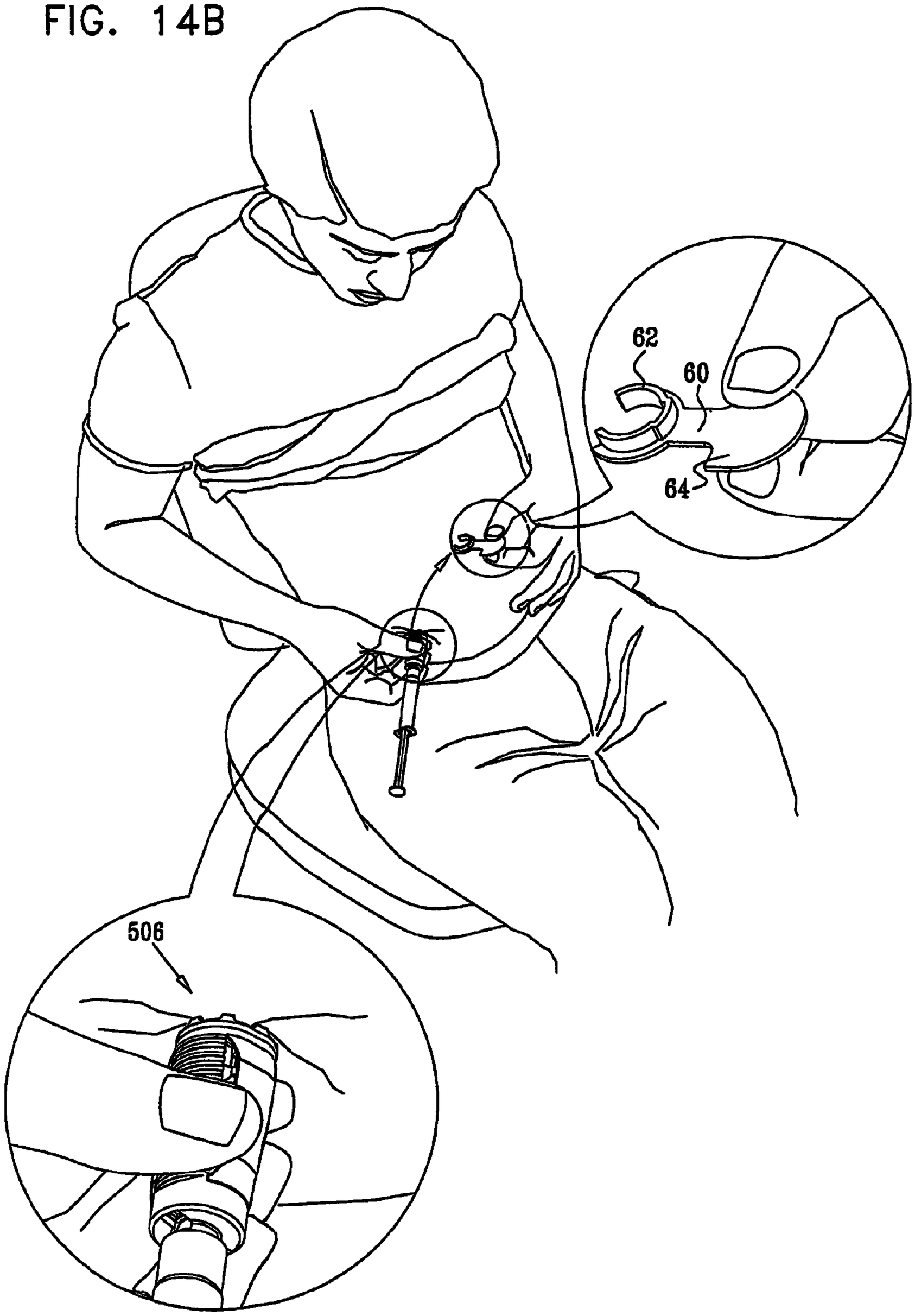


FIG. 14A

FIG. 14B



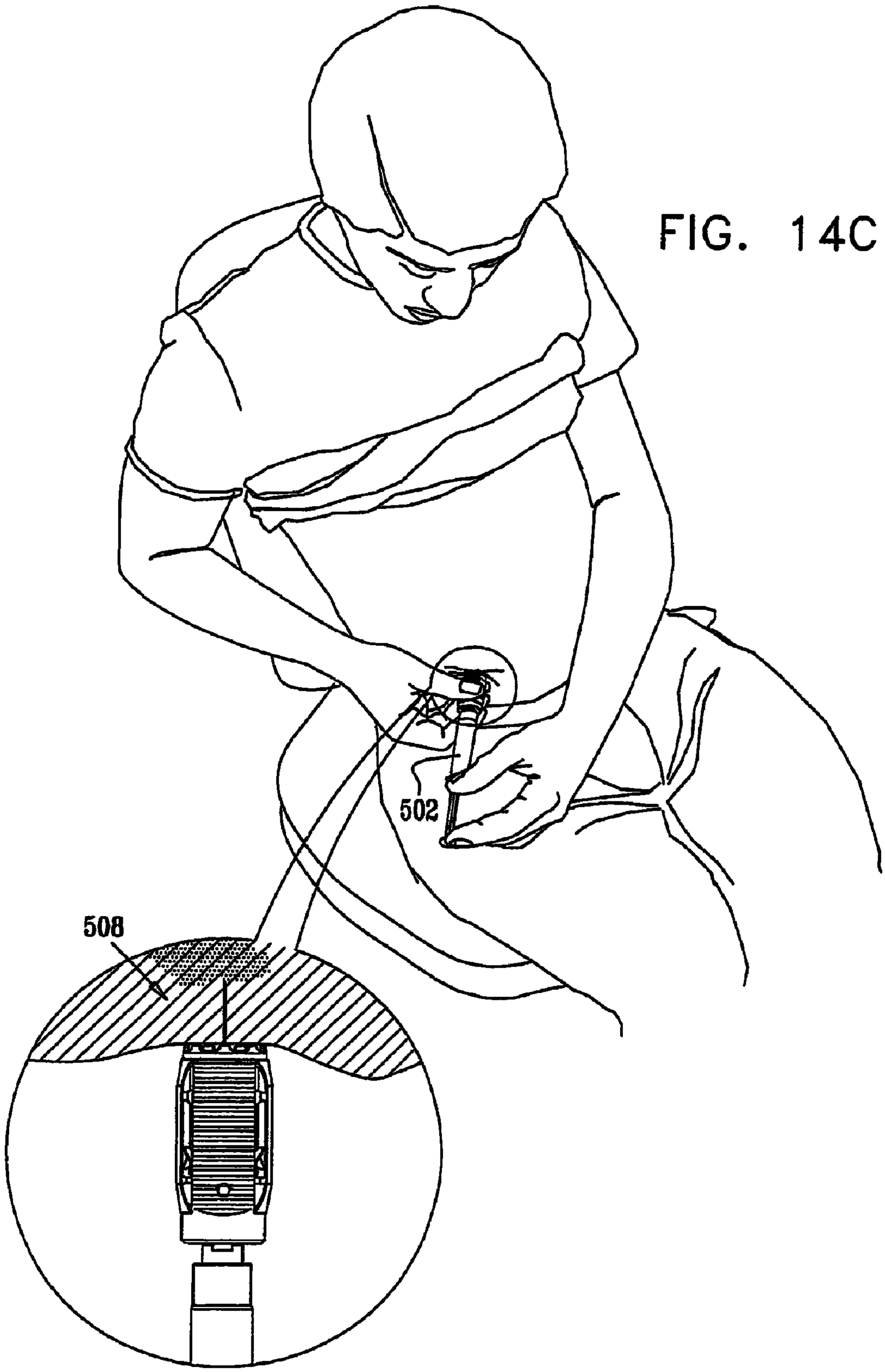
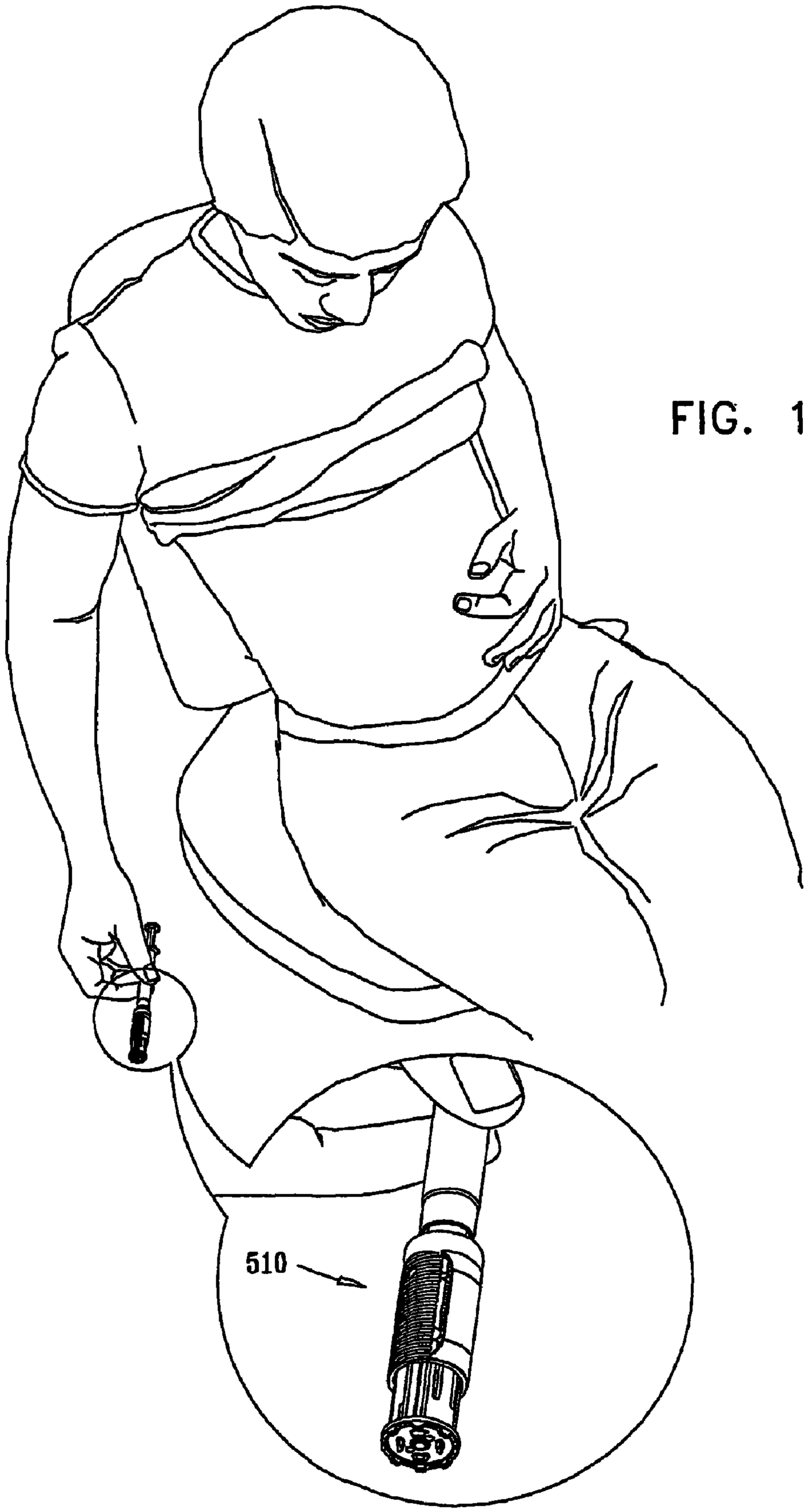


FIG. 14C



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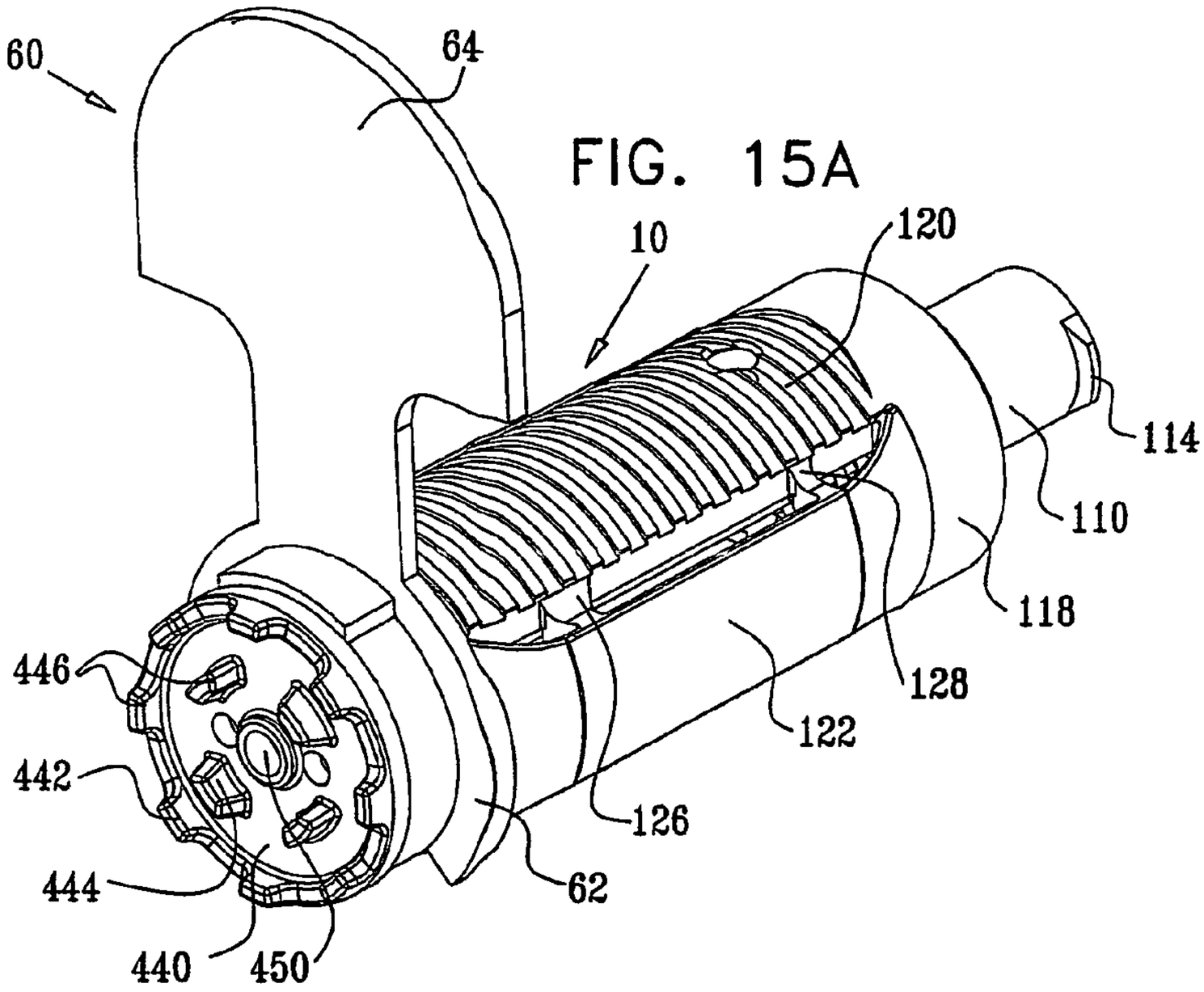

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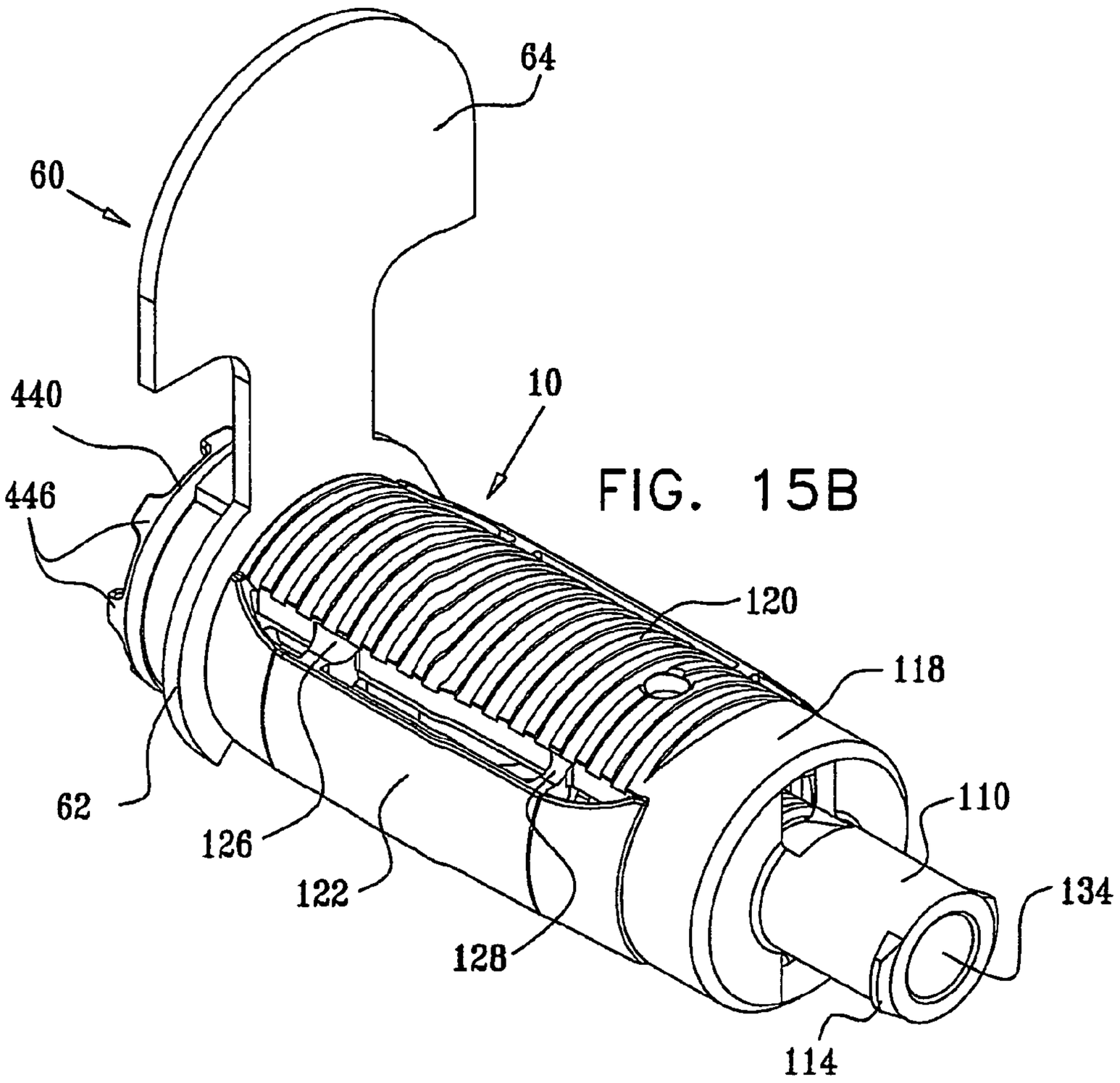
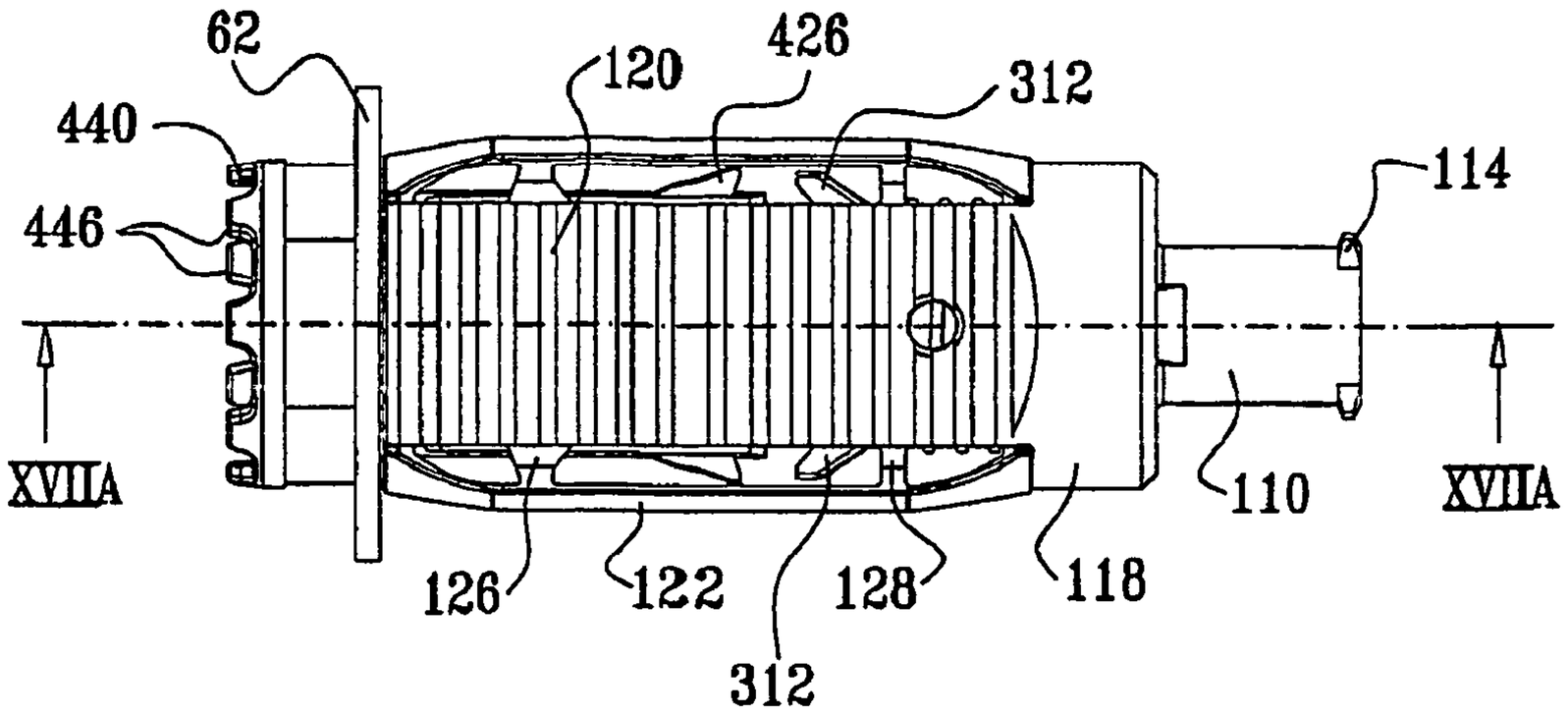


FIG. 15B

FIG. 16A



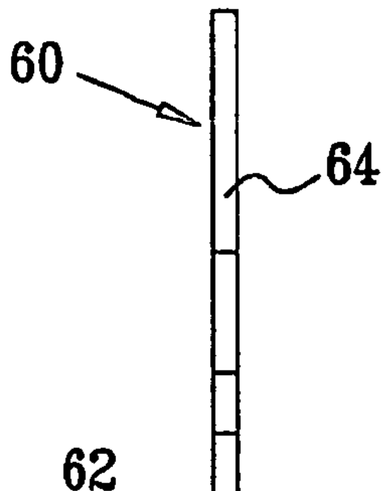
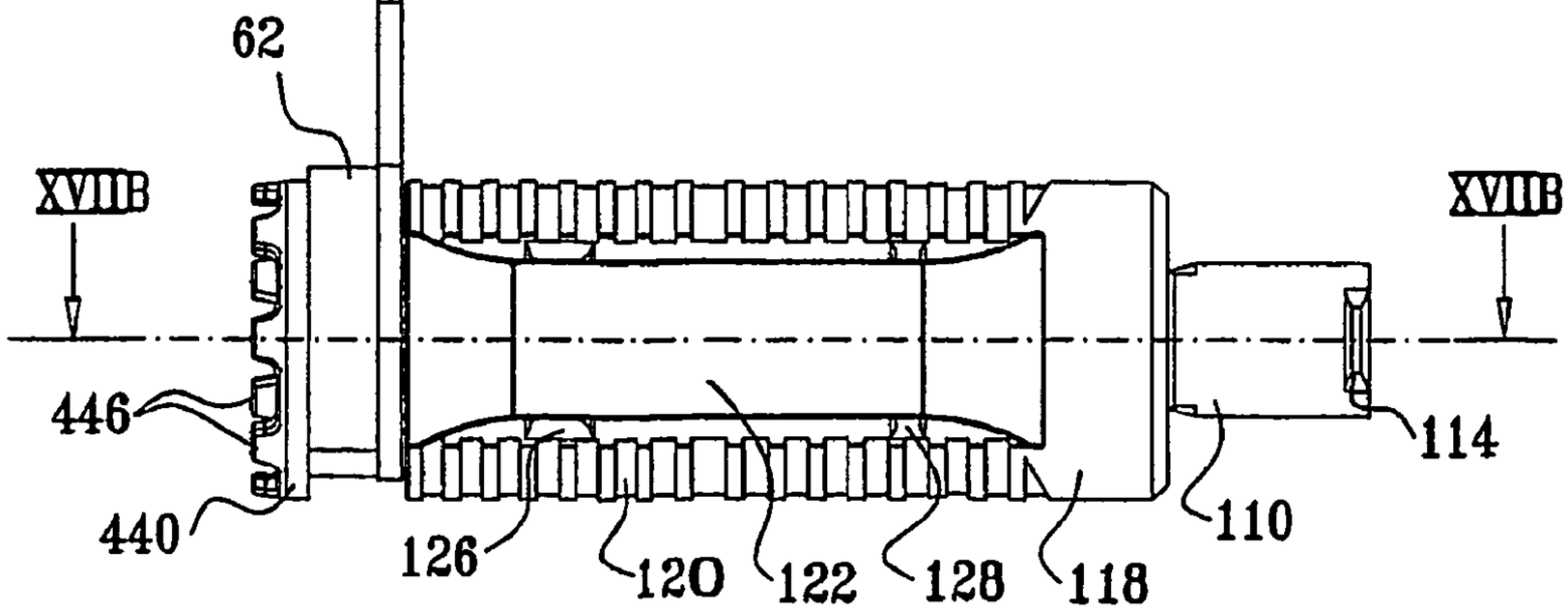


FIG. 16B



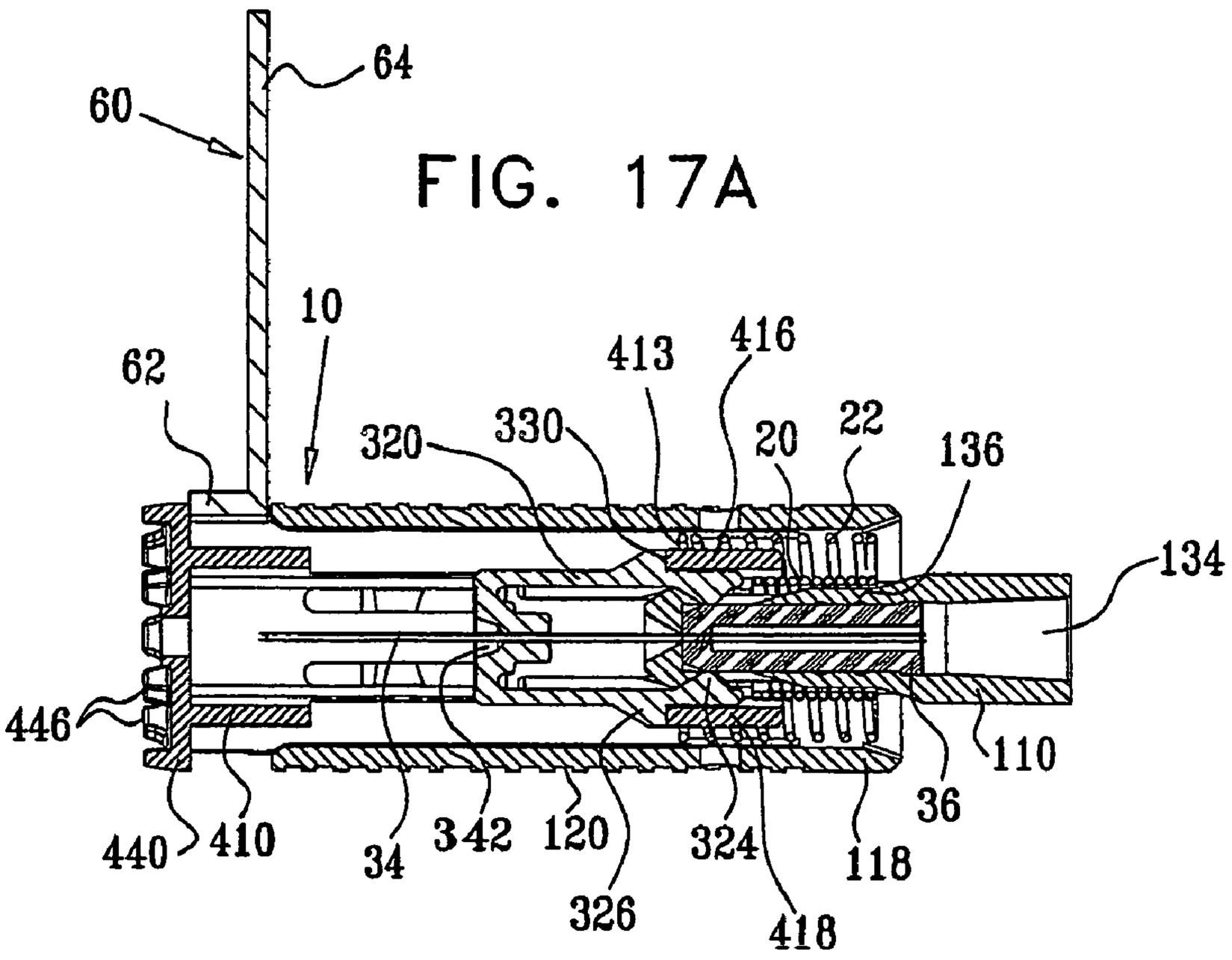


FIG. 17A

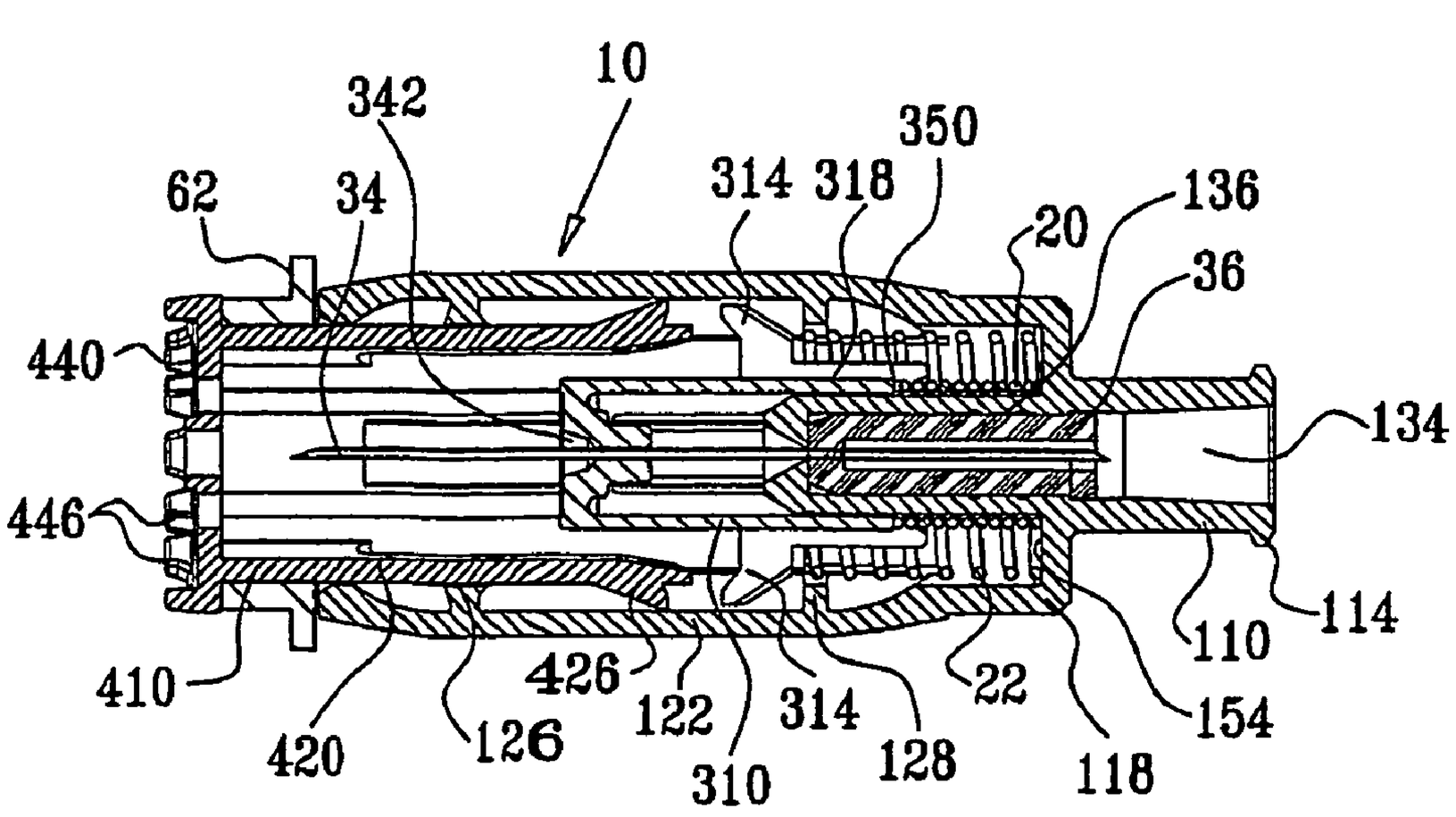


FIG. 17B

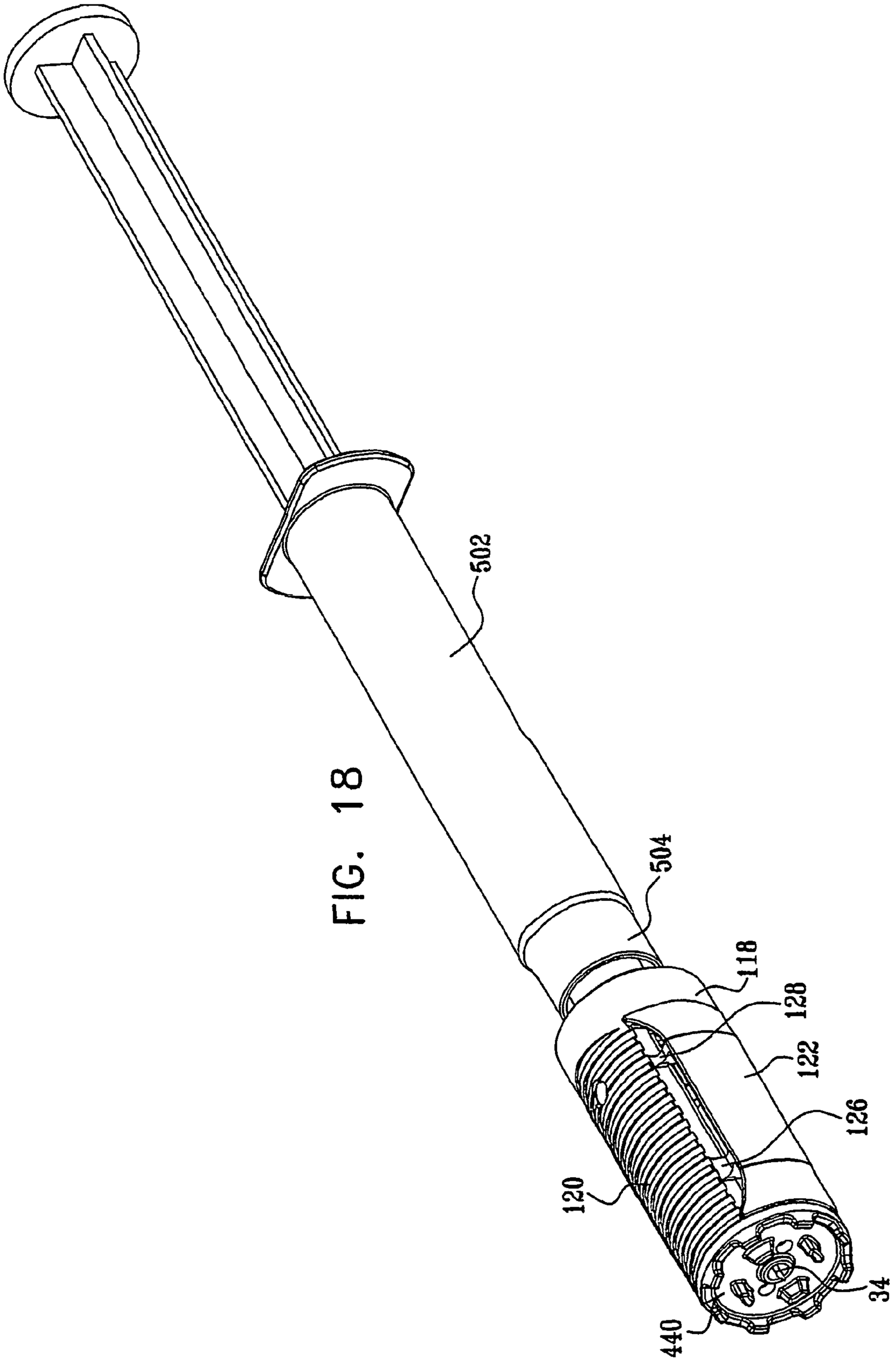


FIG. 18

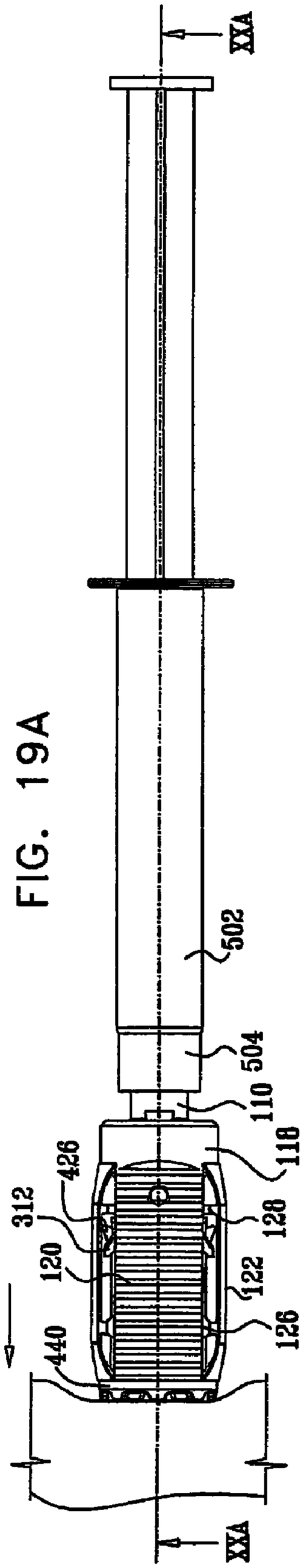


FIG. 19A

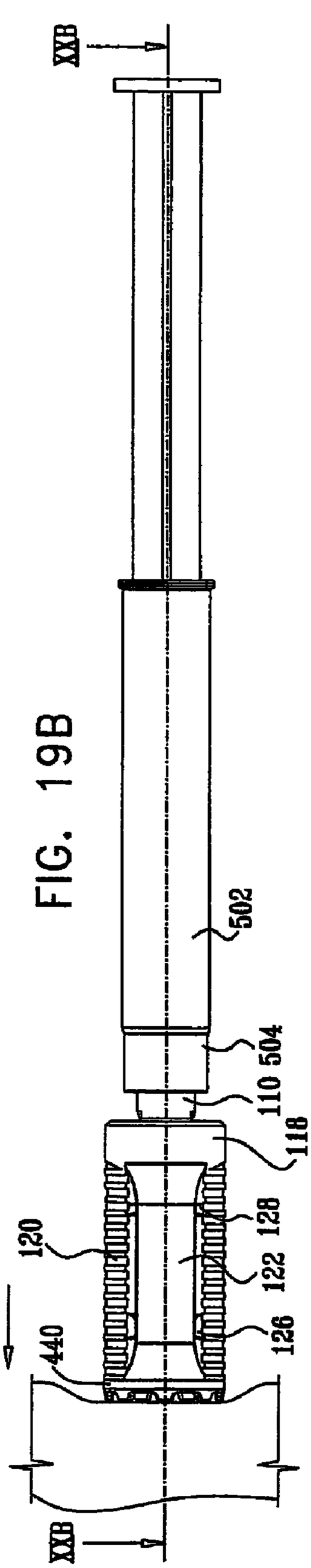


FIG. 19B

FIG. 20A

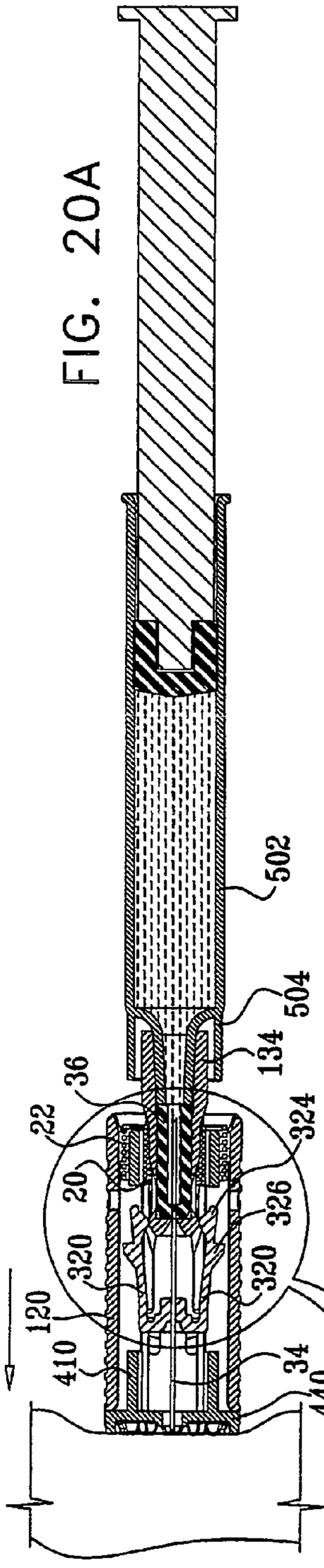
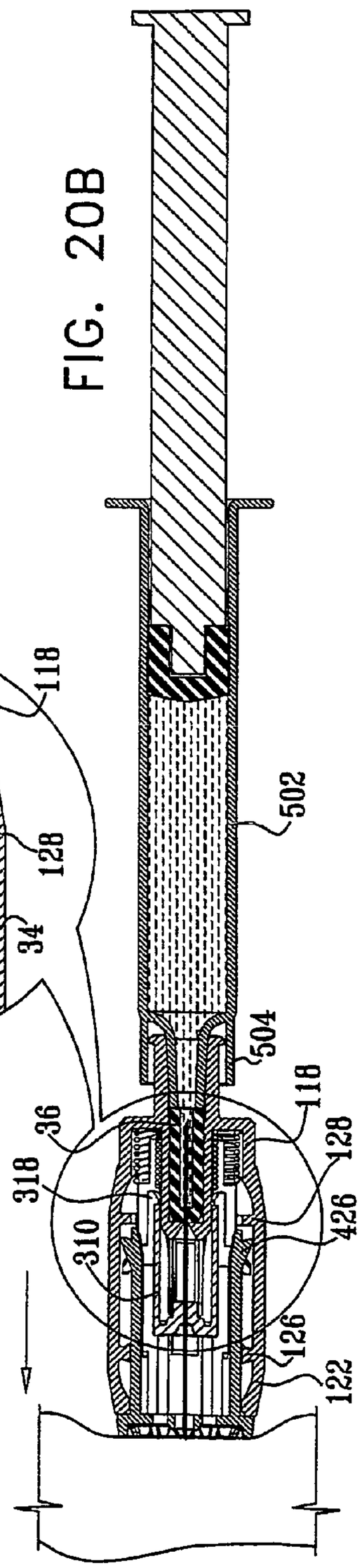


FIG. 20B



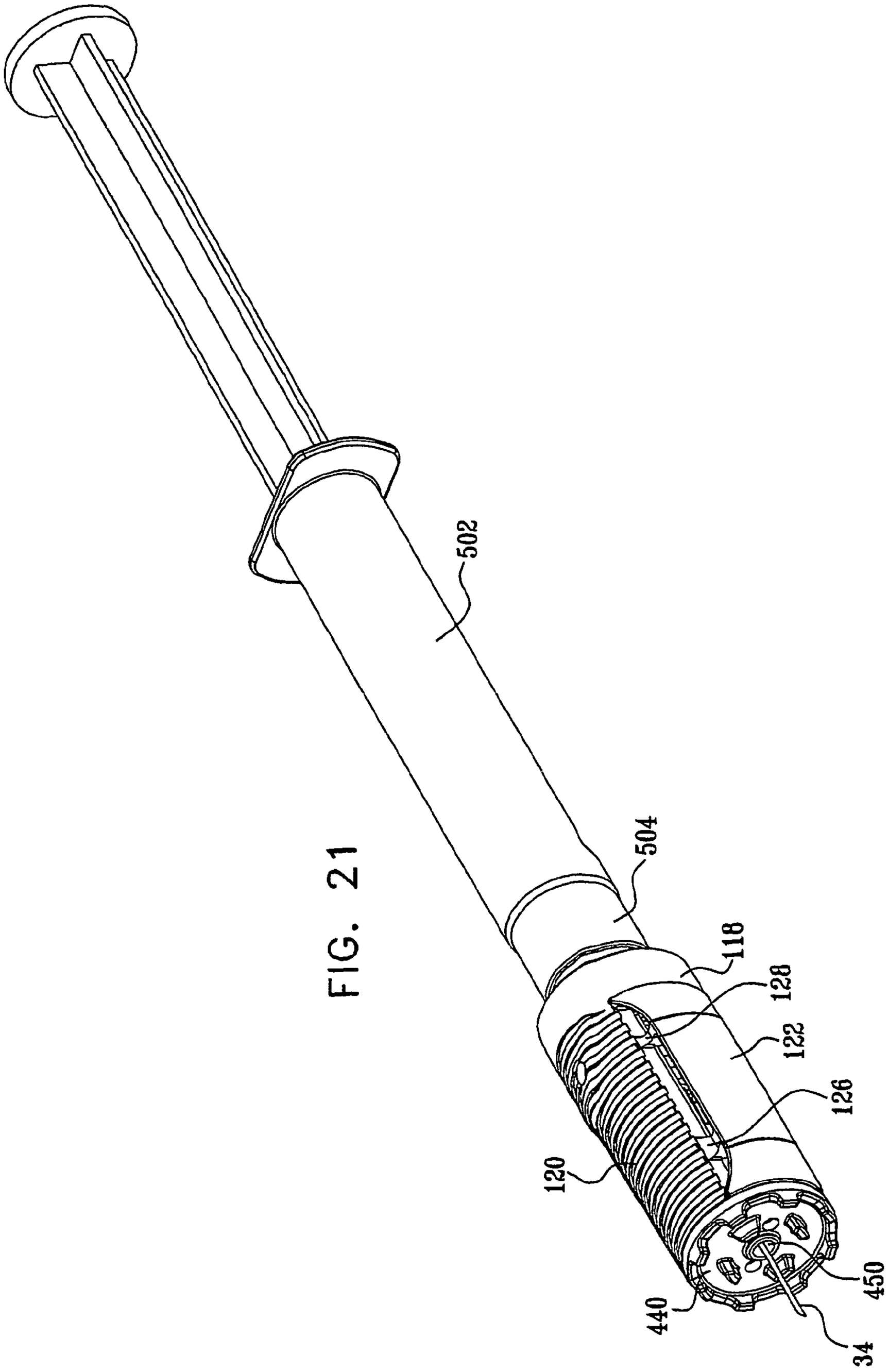


FIG. 21

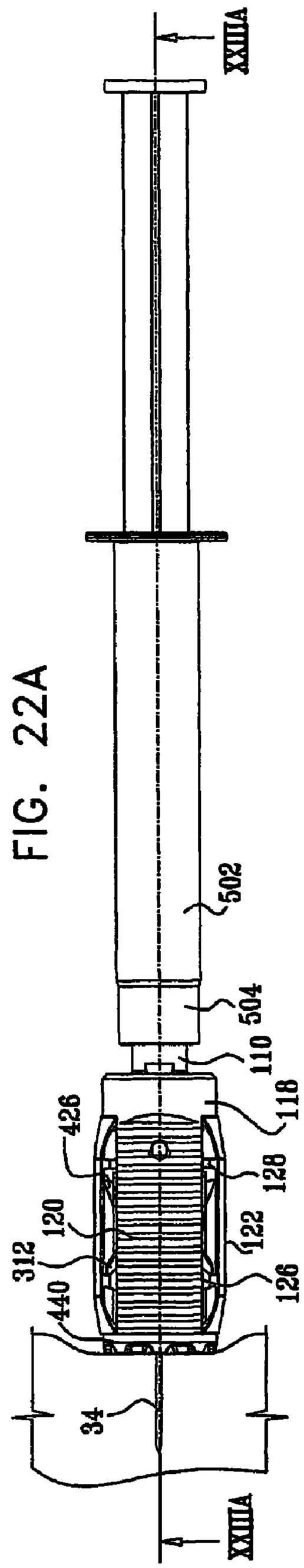


FIG. 22A

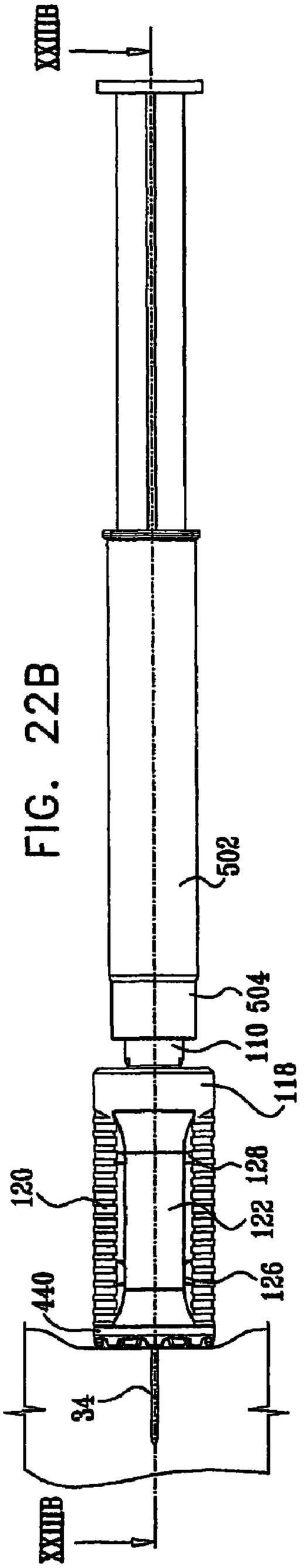


FIG. 22B

FIG. 23A

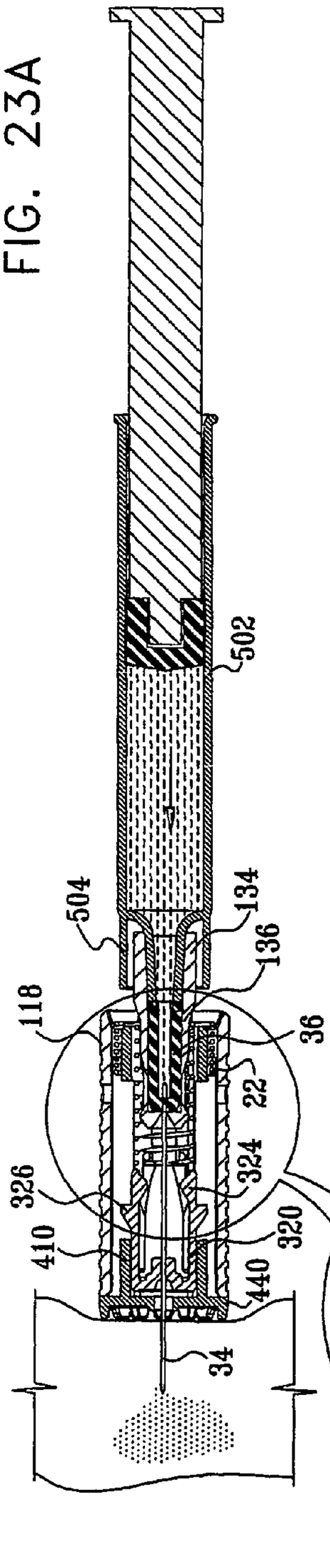
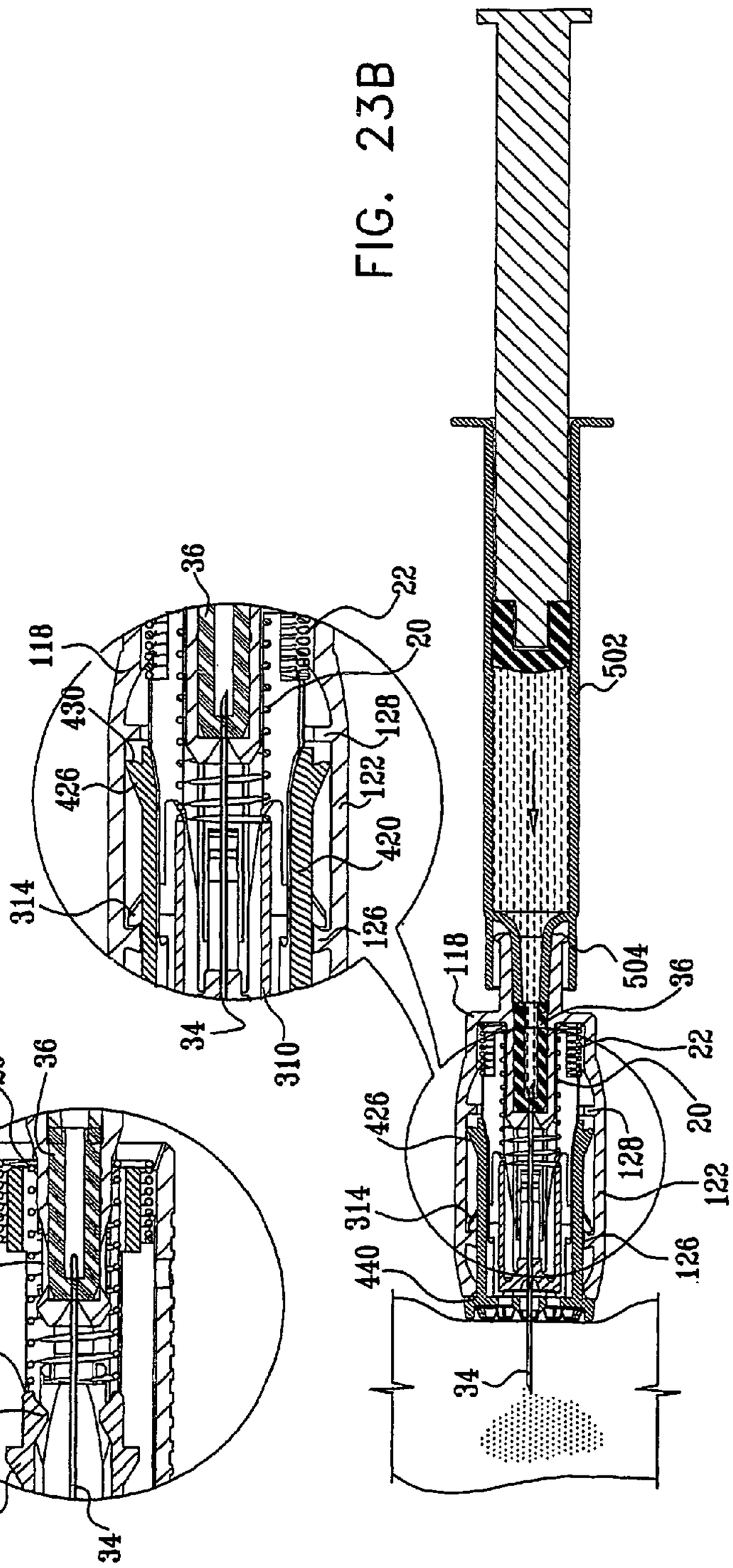


FIG. 23B



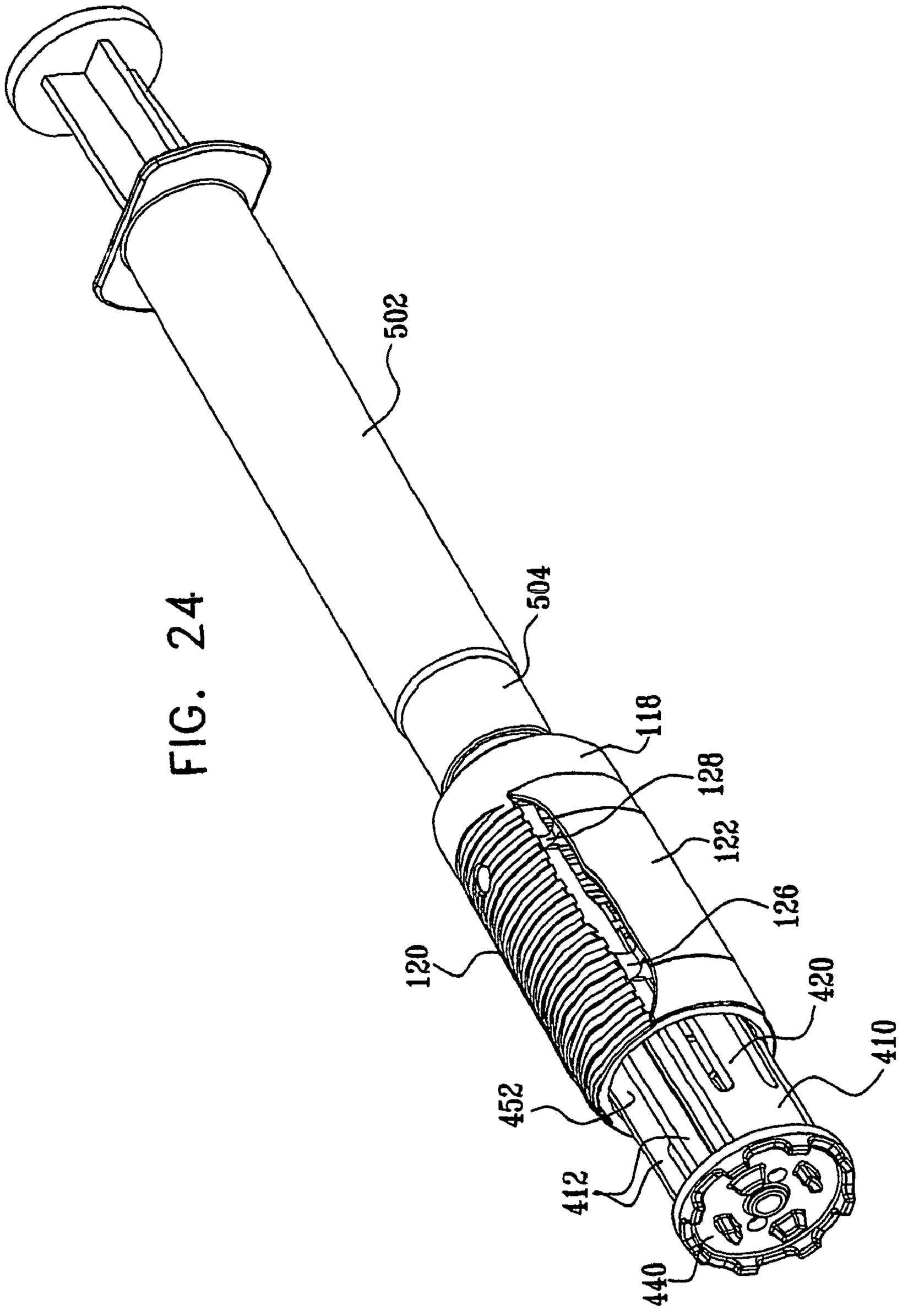


FIG. 24

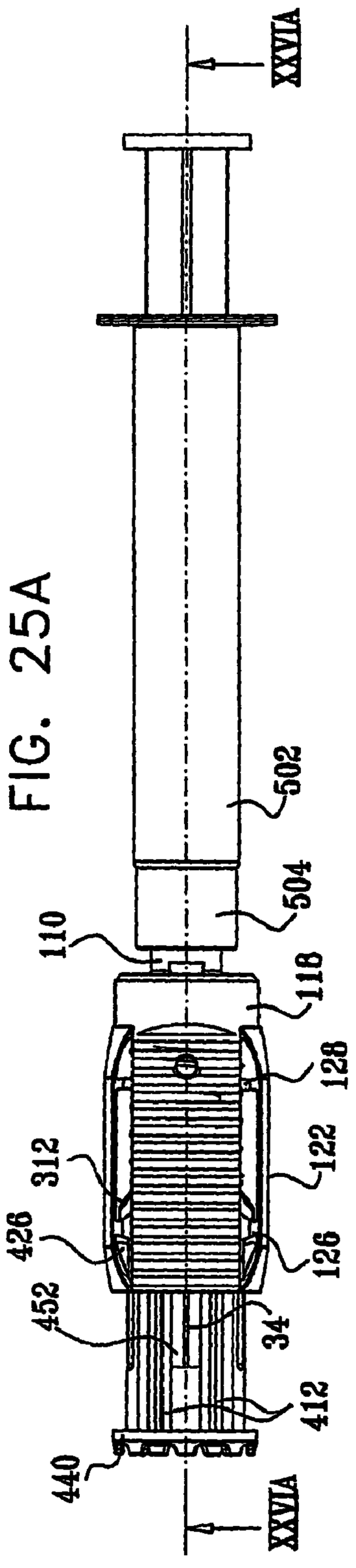


FIG. 25A

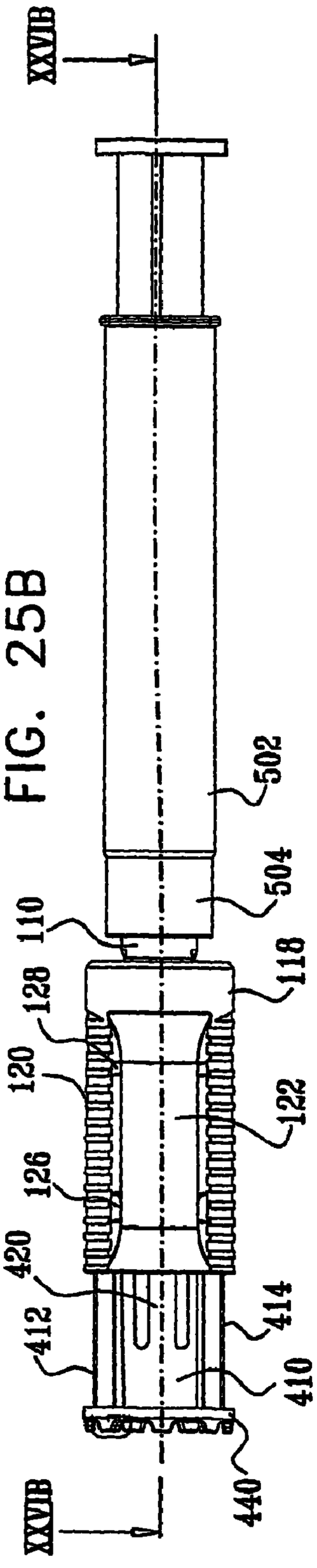


FIG. 25B

FIG. 26A

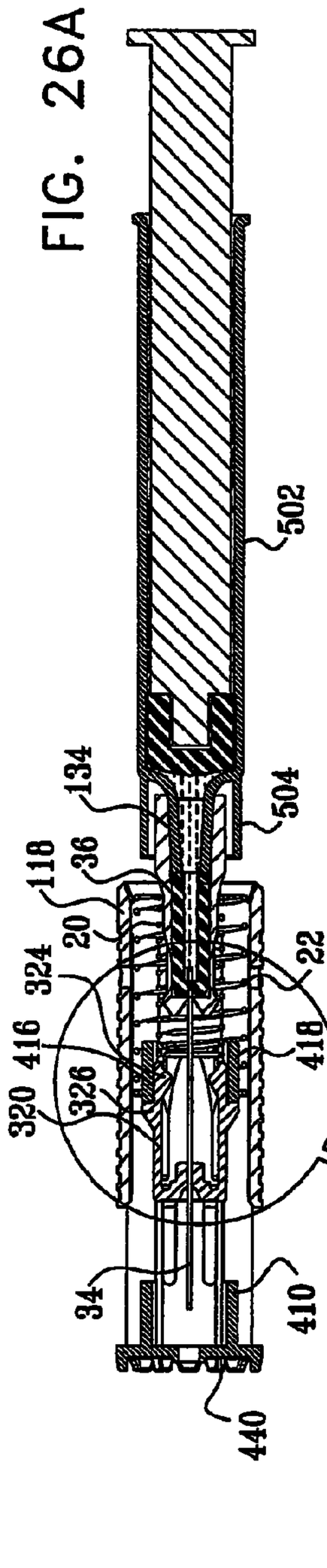
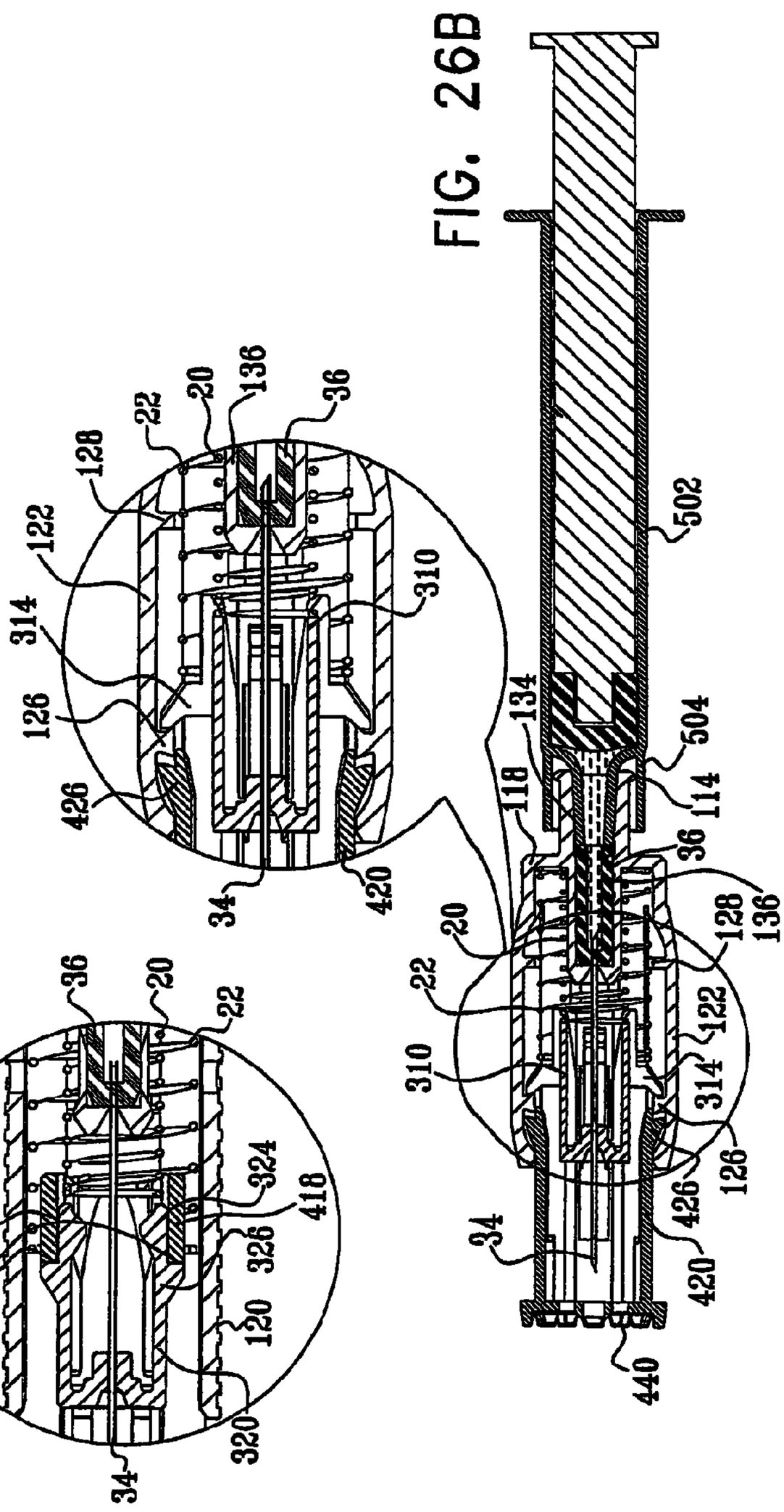


FIG. 26B



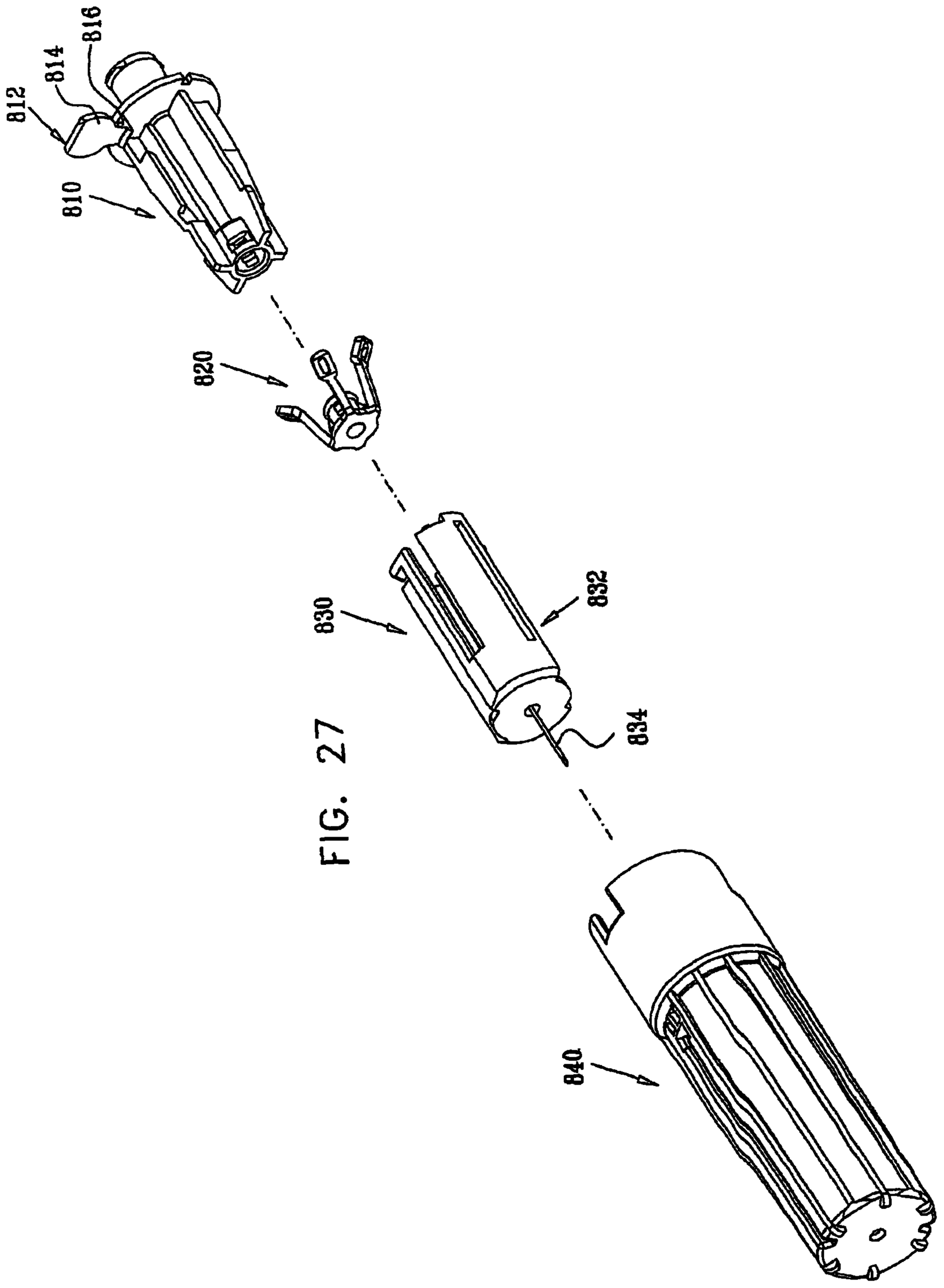


FIG. 27

FIG. 28A

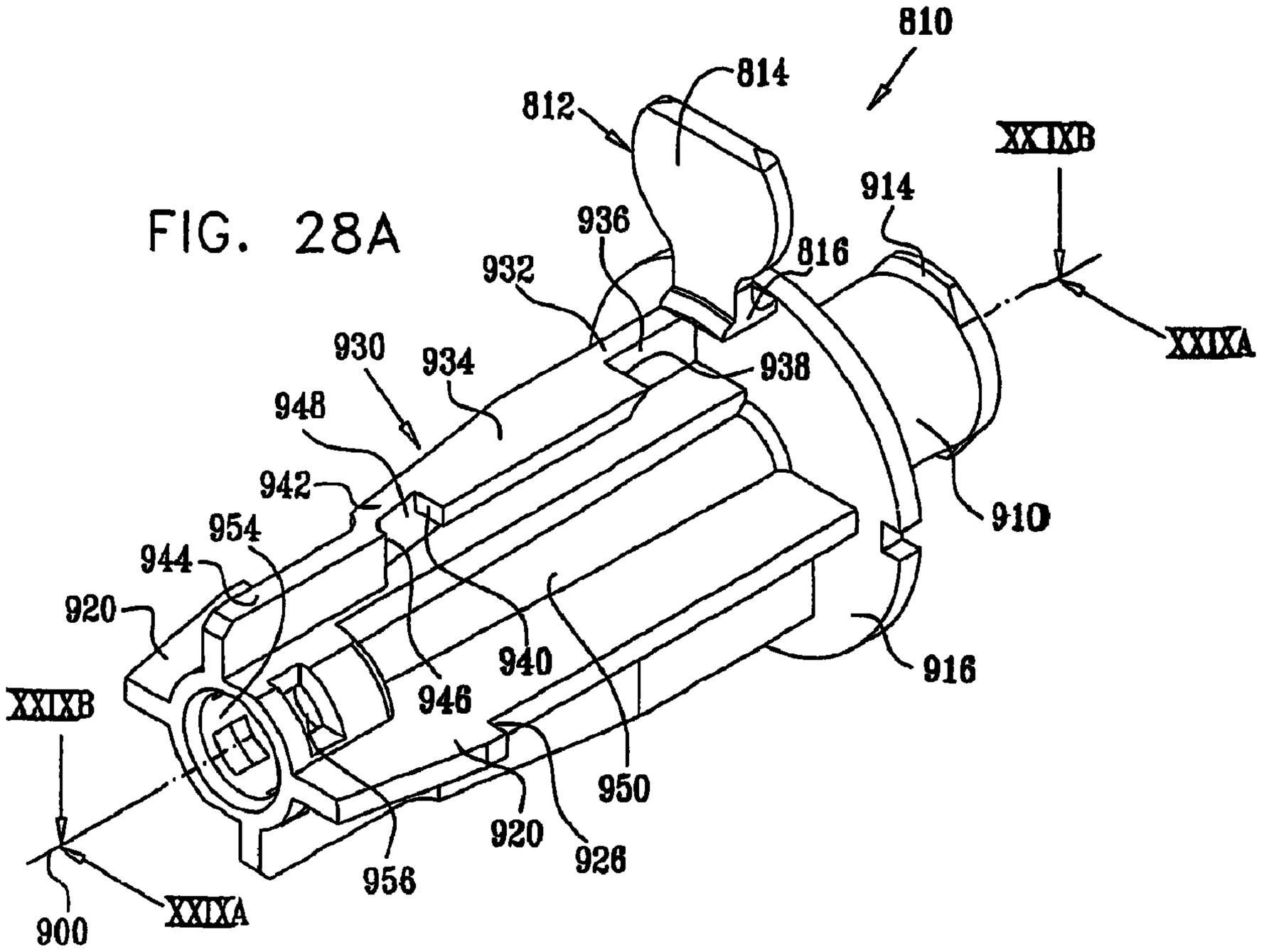


FIG. 28B

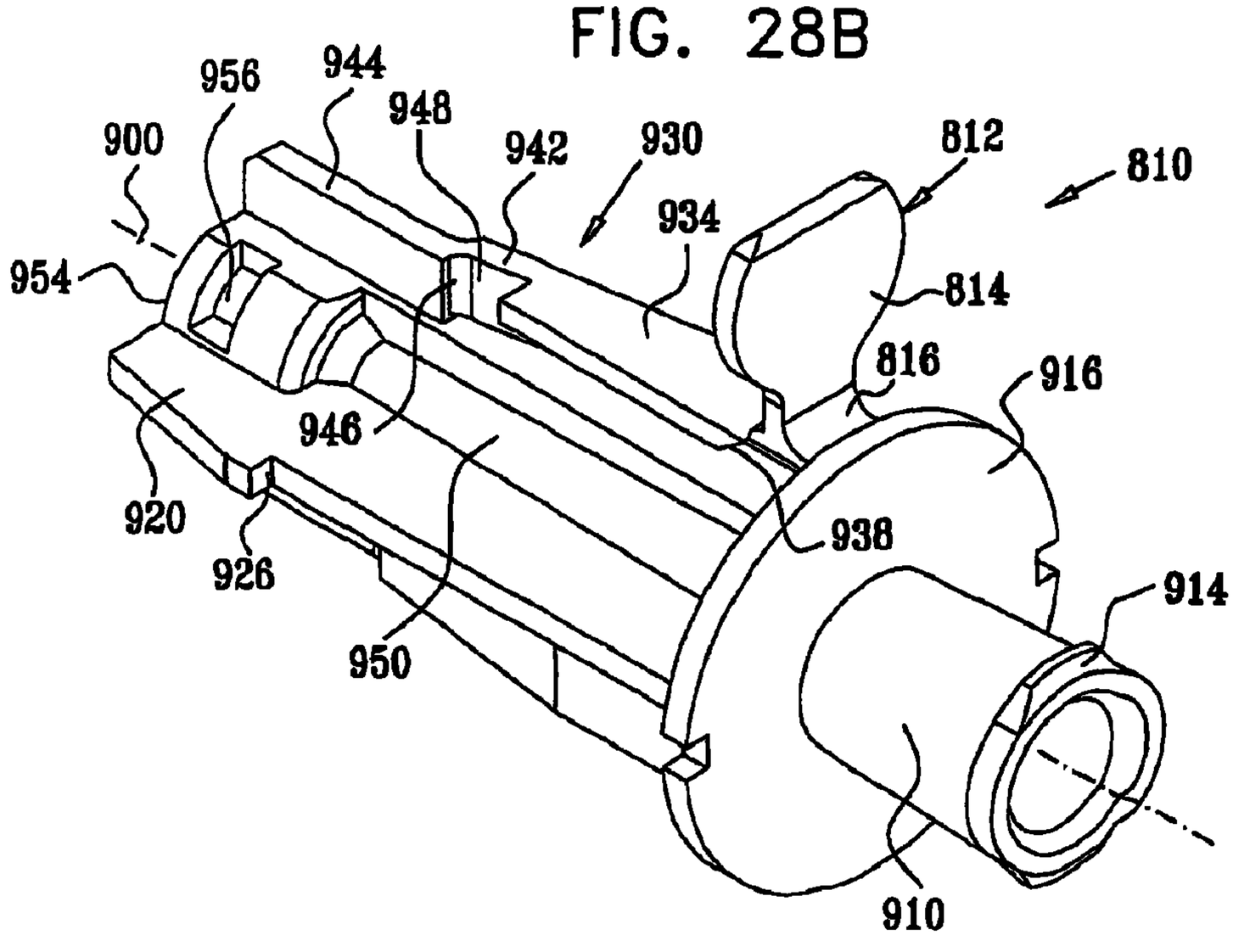


FIG. 29A

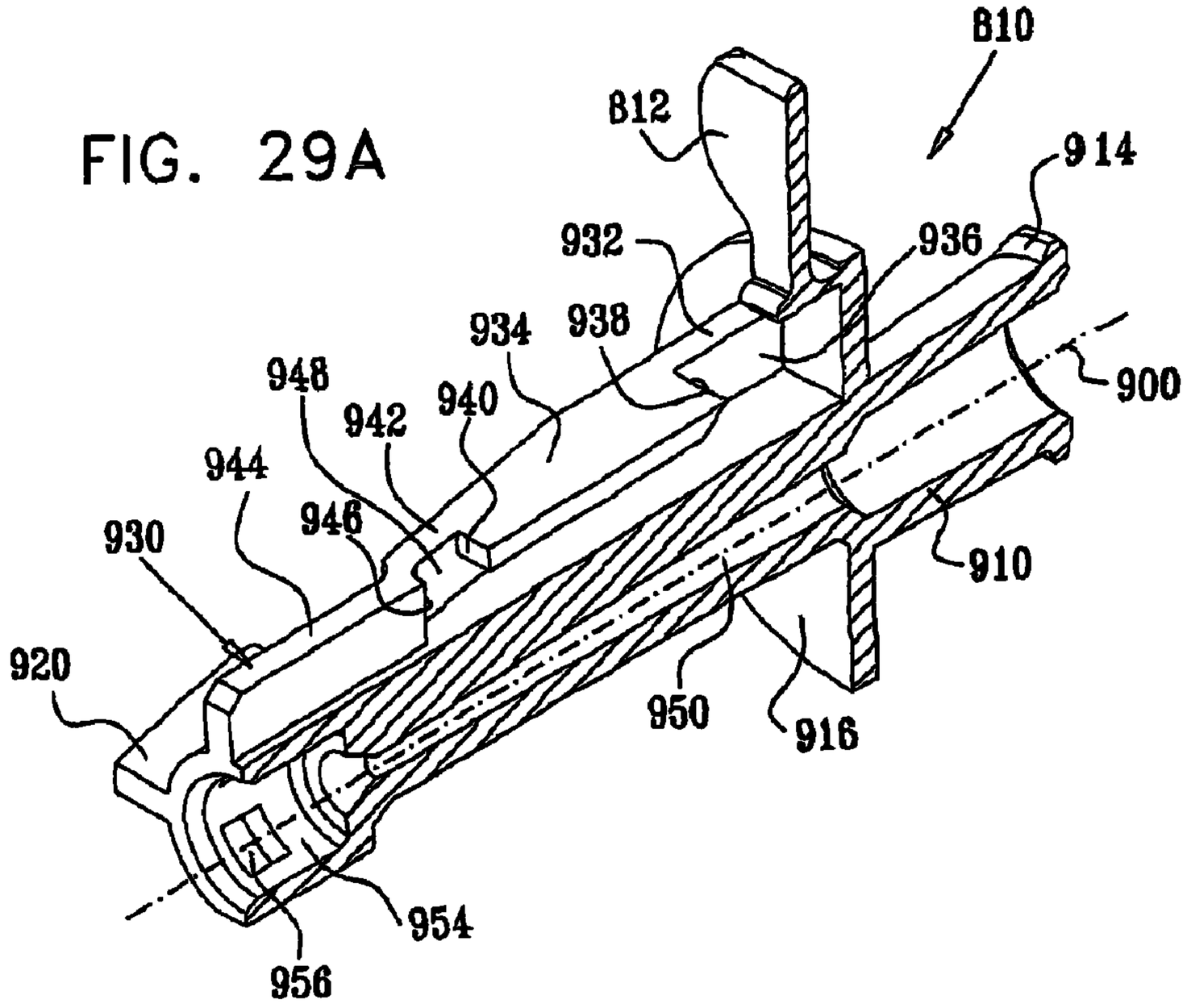


FIG. 29B

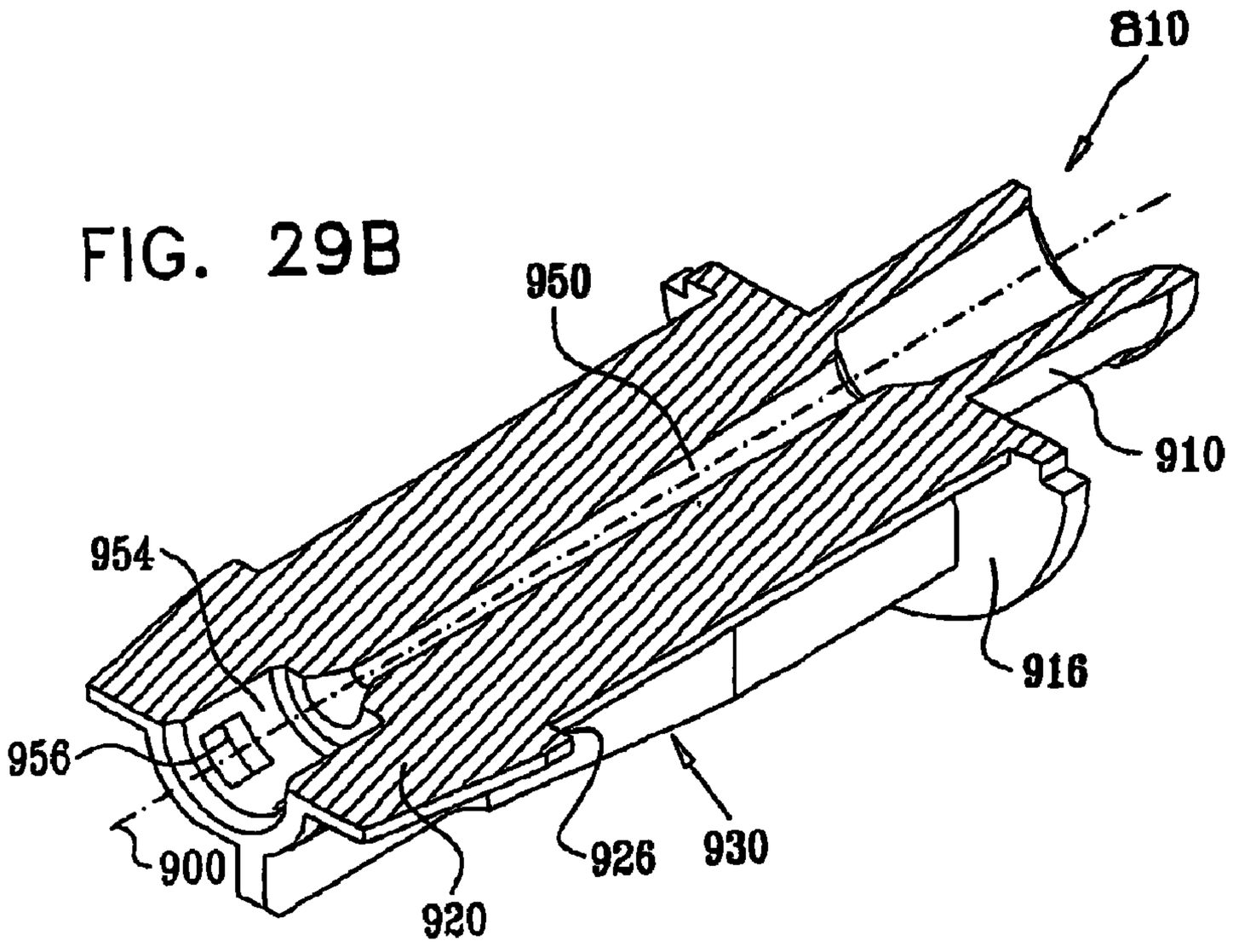


FIG. 30A

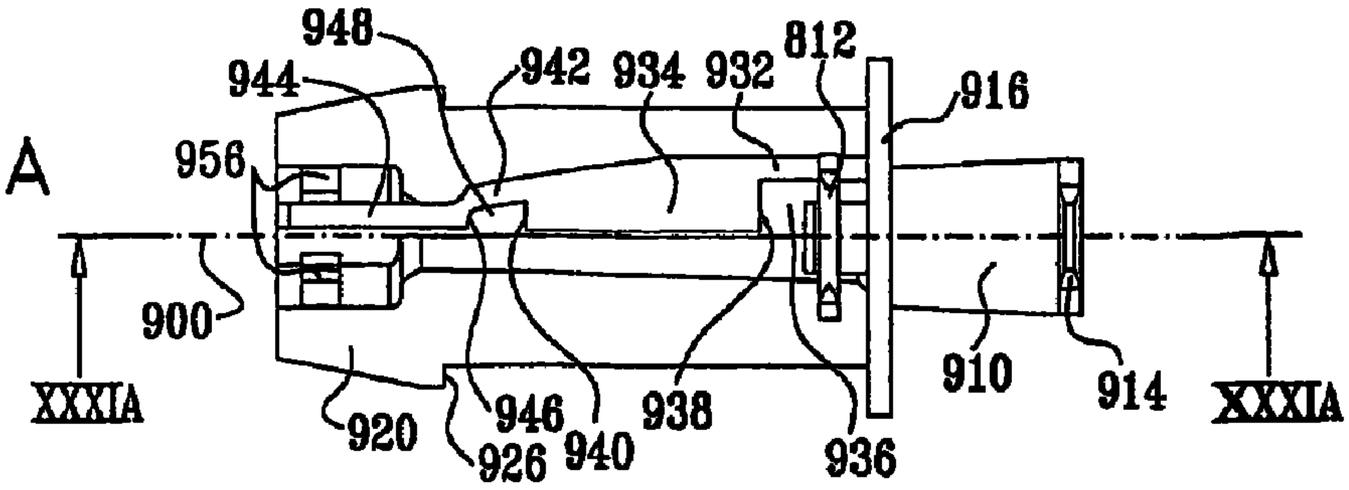


FIG. 30B

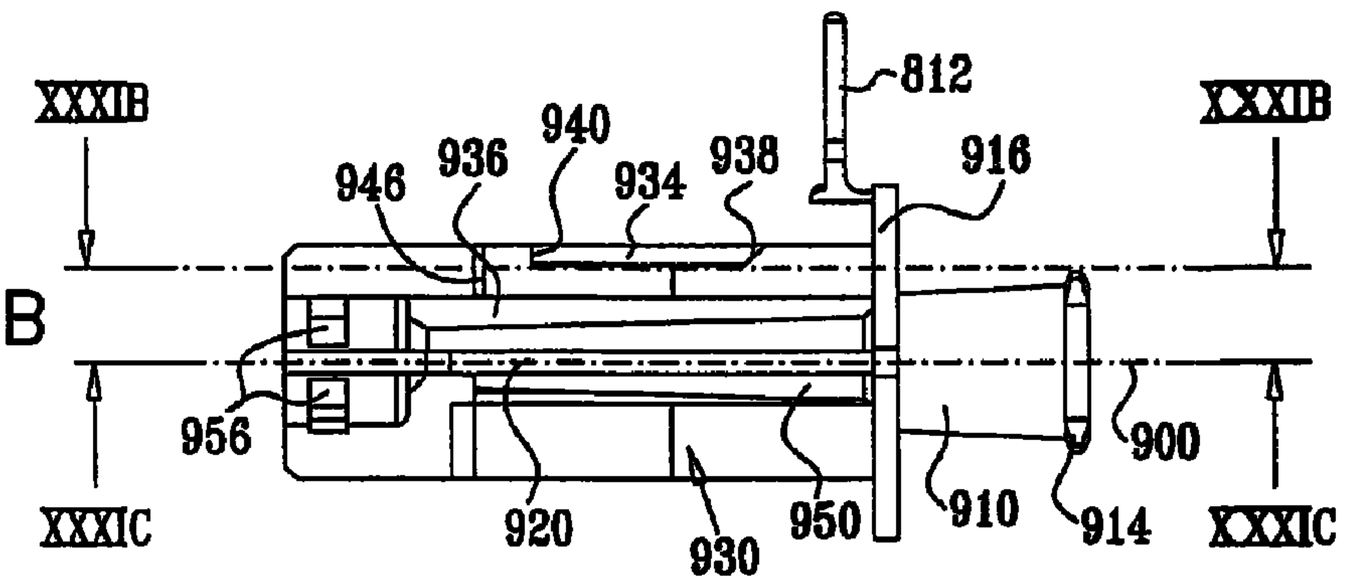


FIG. 31A

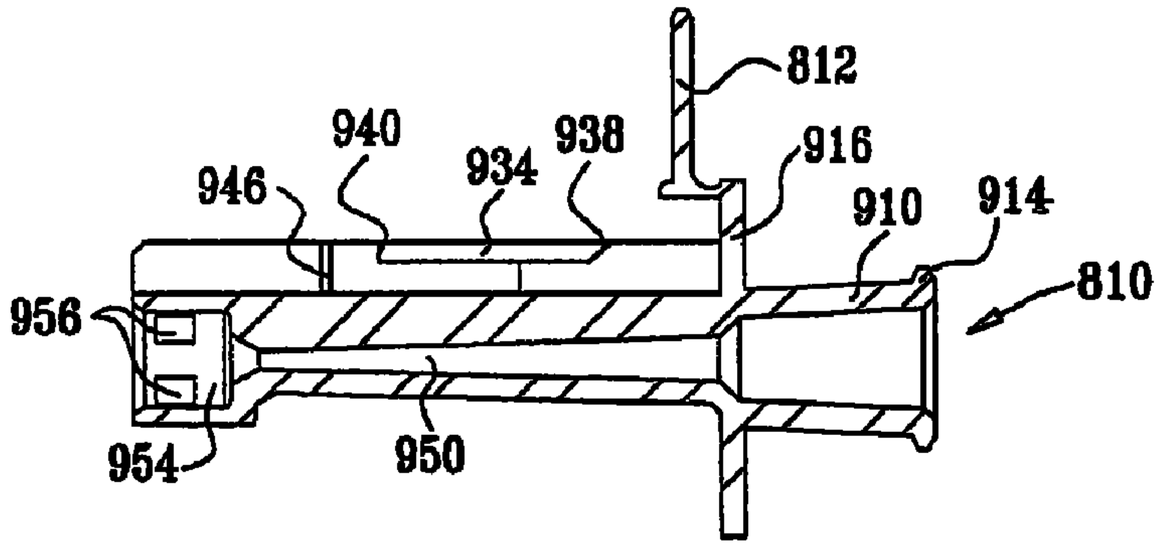


FIG. 31B

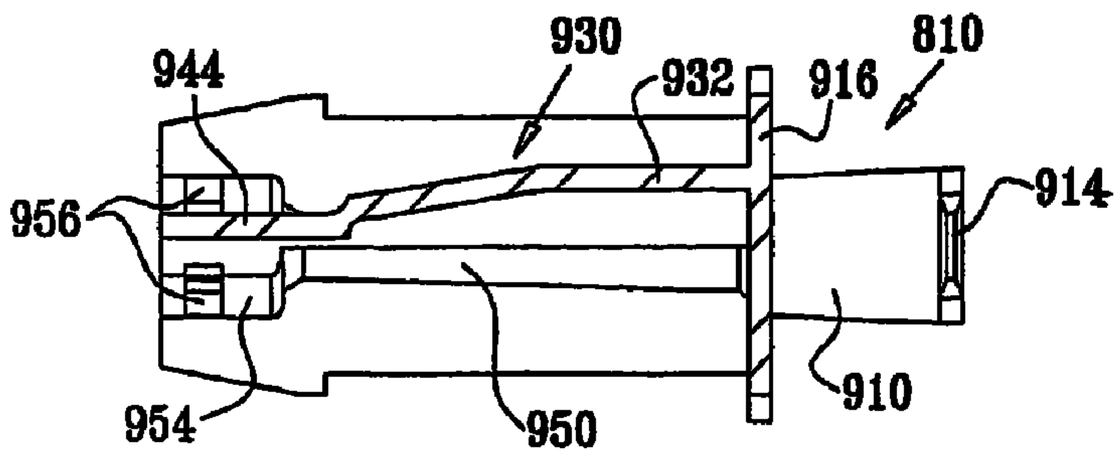


FIG. 31C

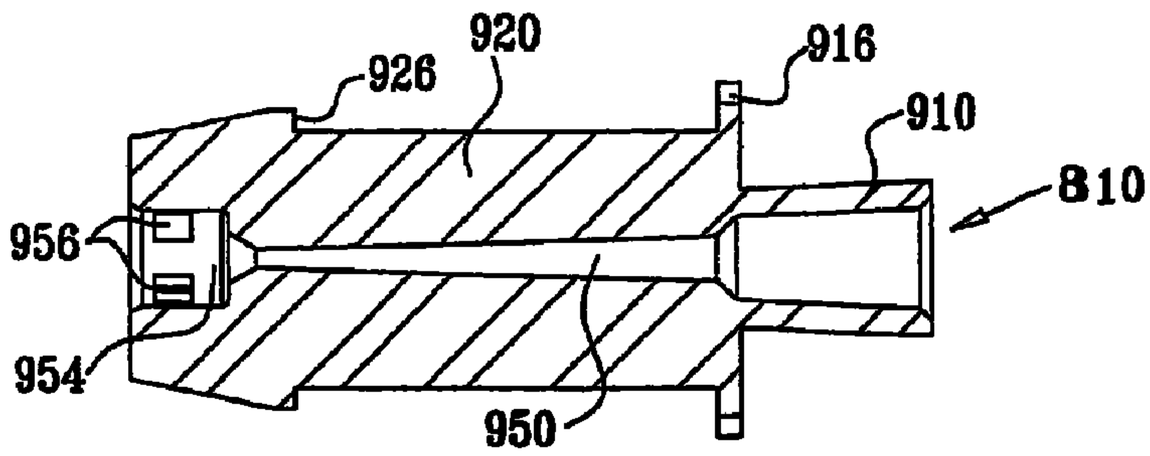


FIG. 32A

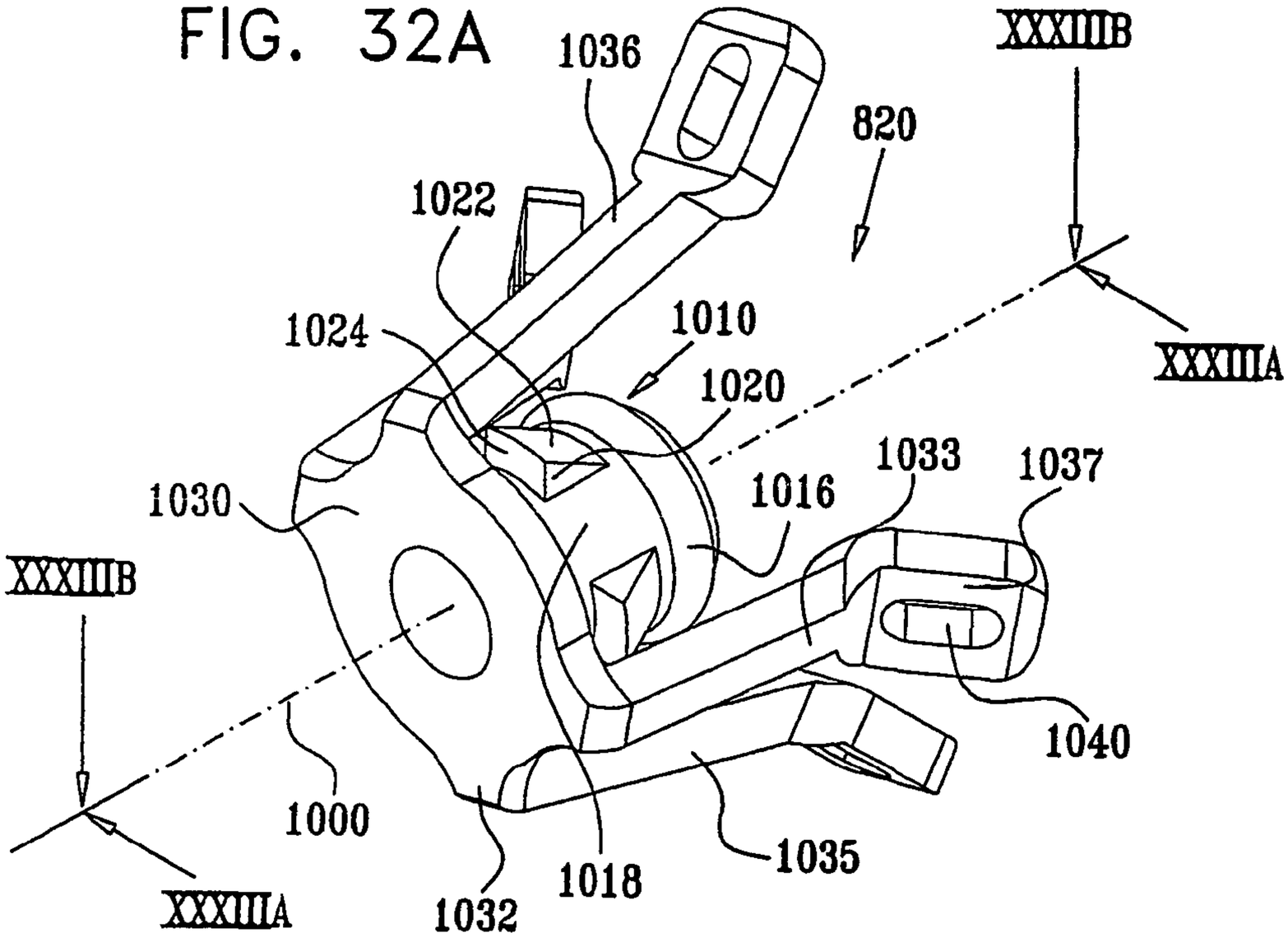


FIG. 32B

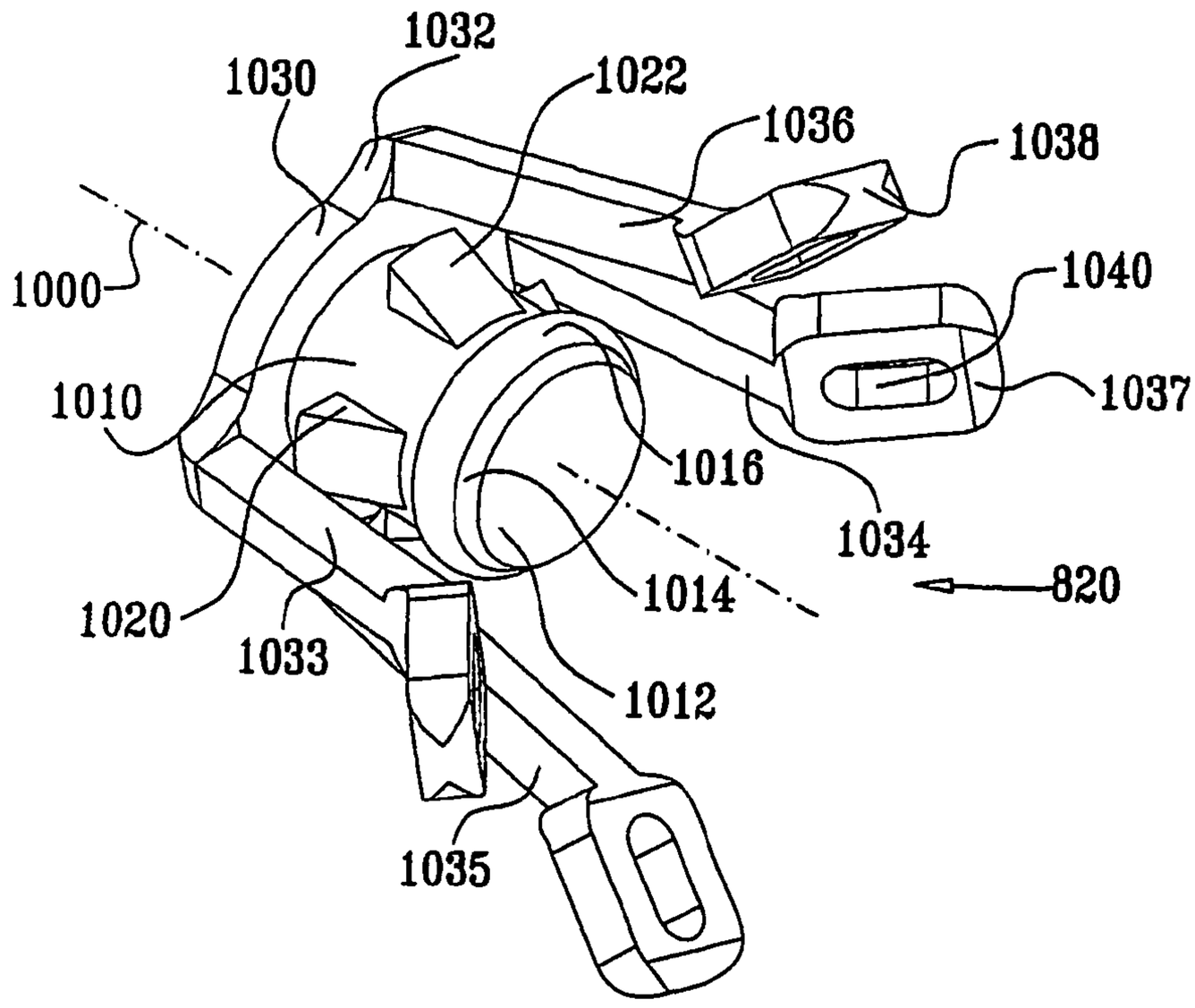


FIG. 33A

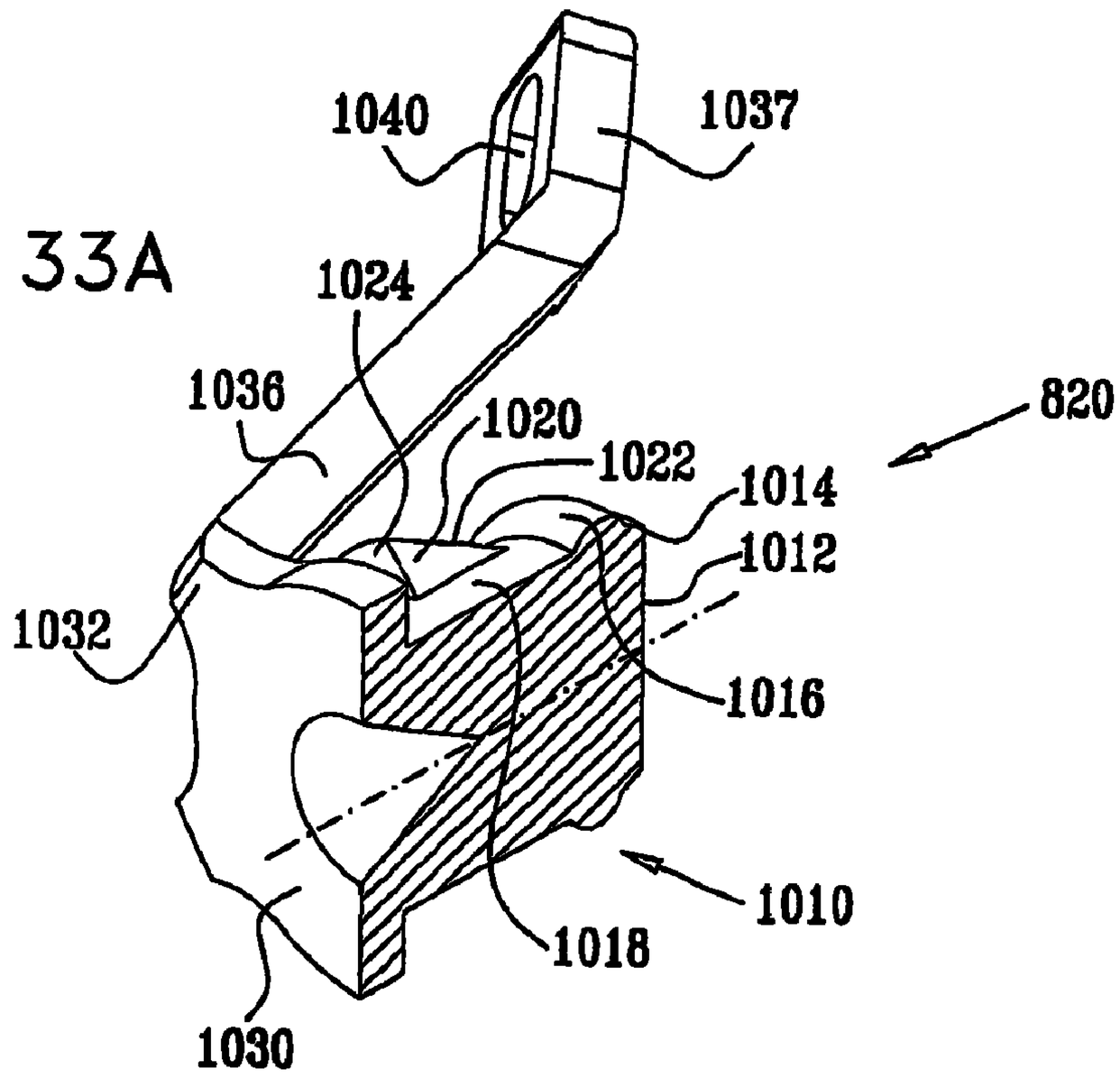


FIG. 33B

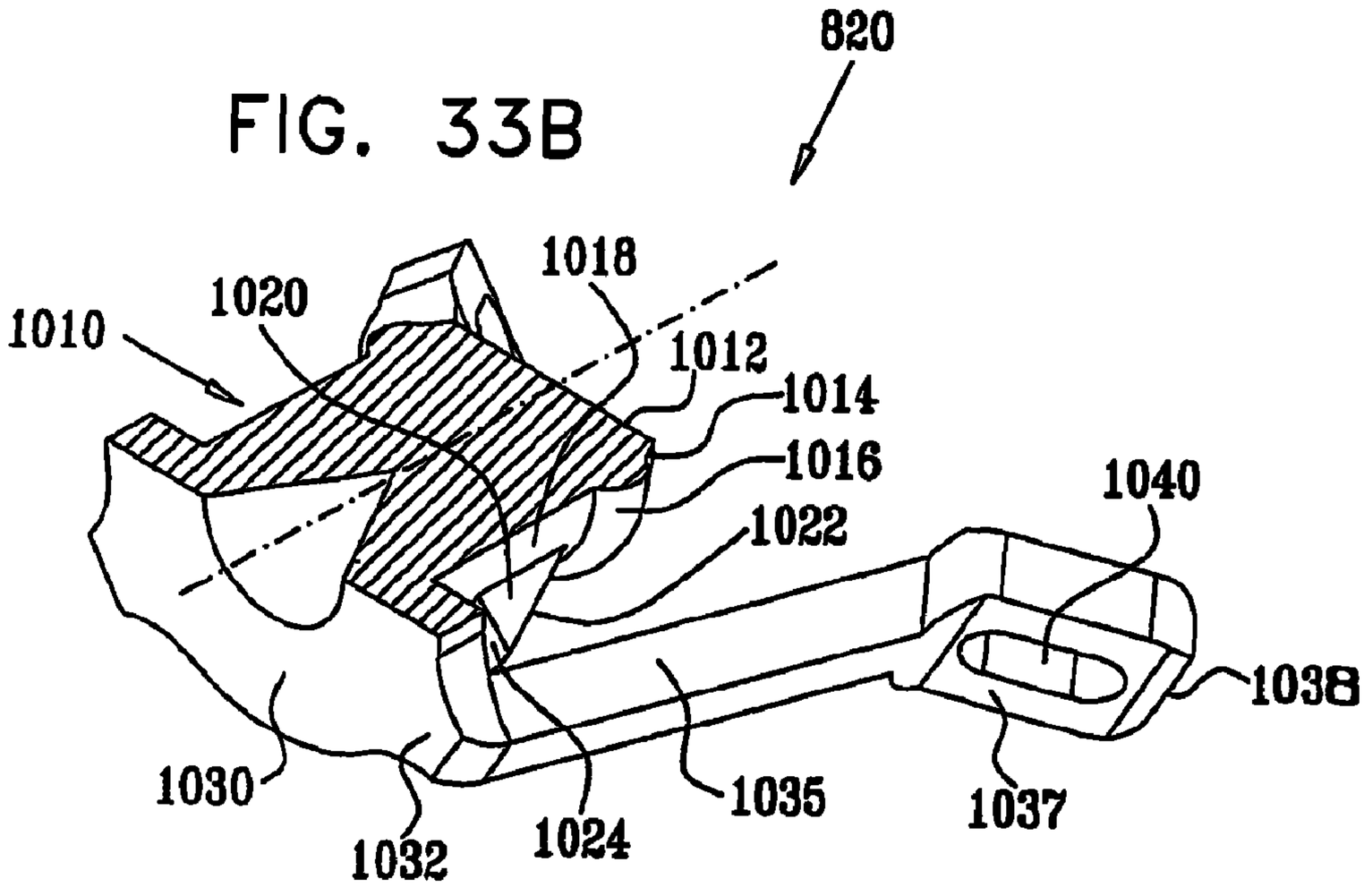


FIG. 34A

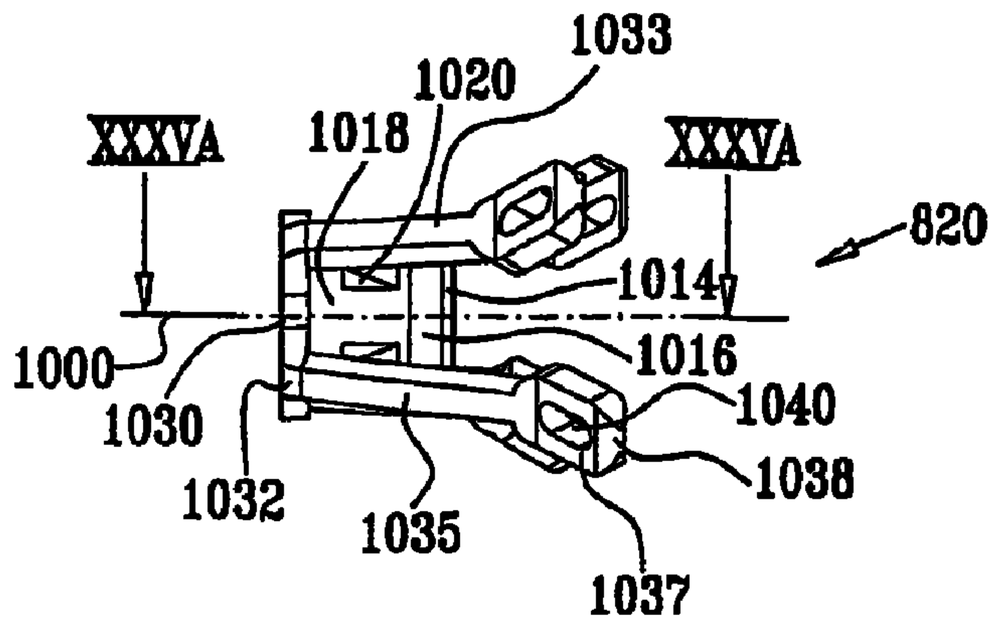


FIG. 34B

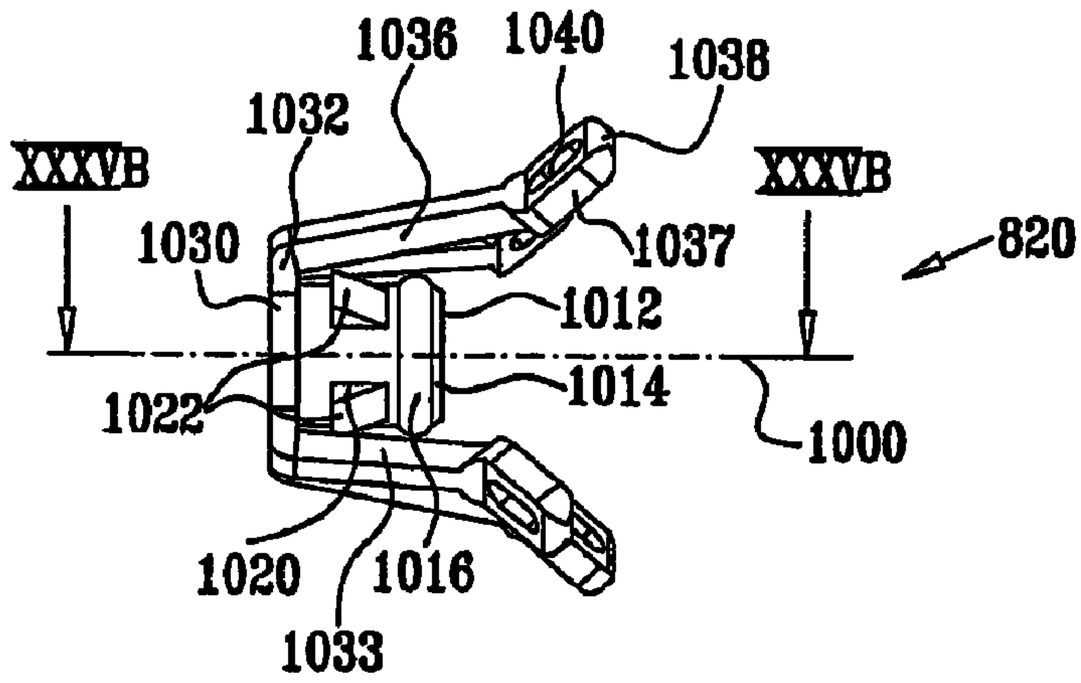


FIG. 35A

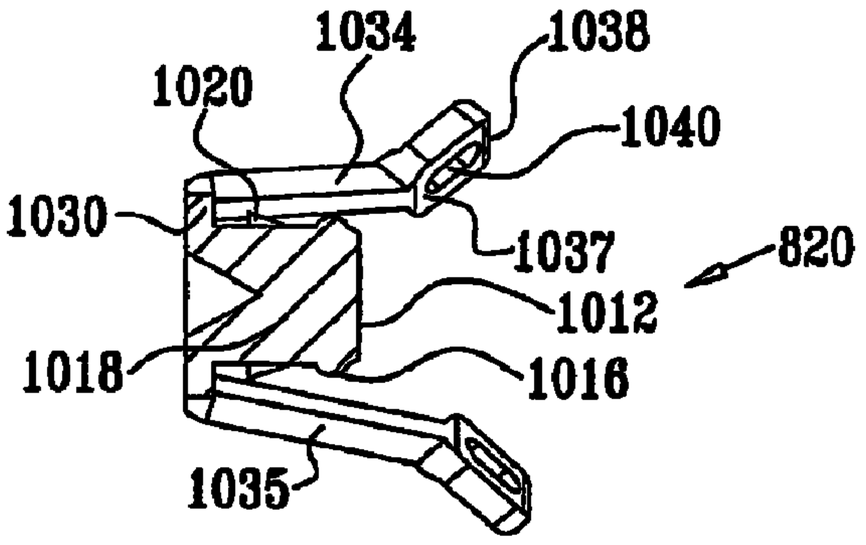


FIG. 35B

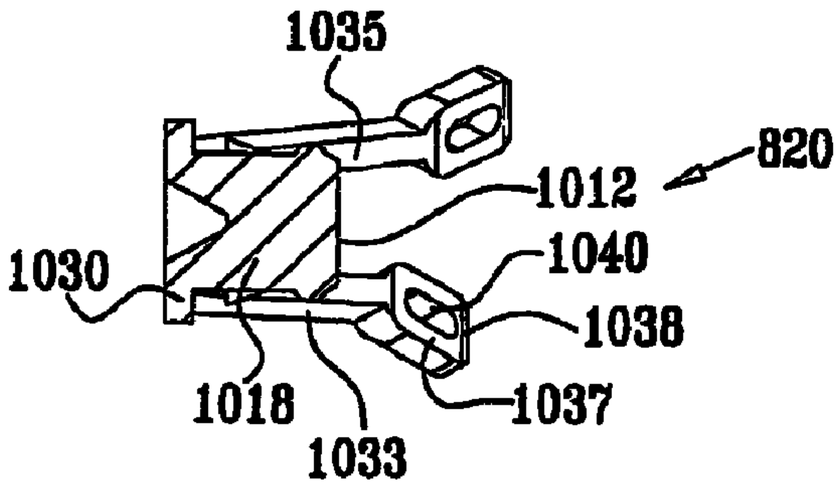


FIG. 36A

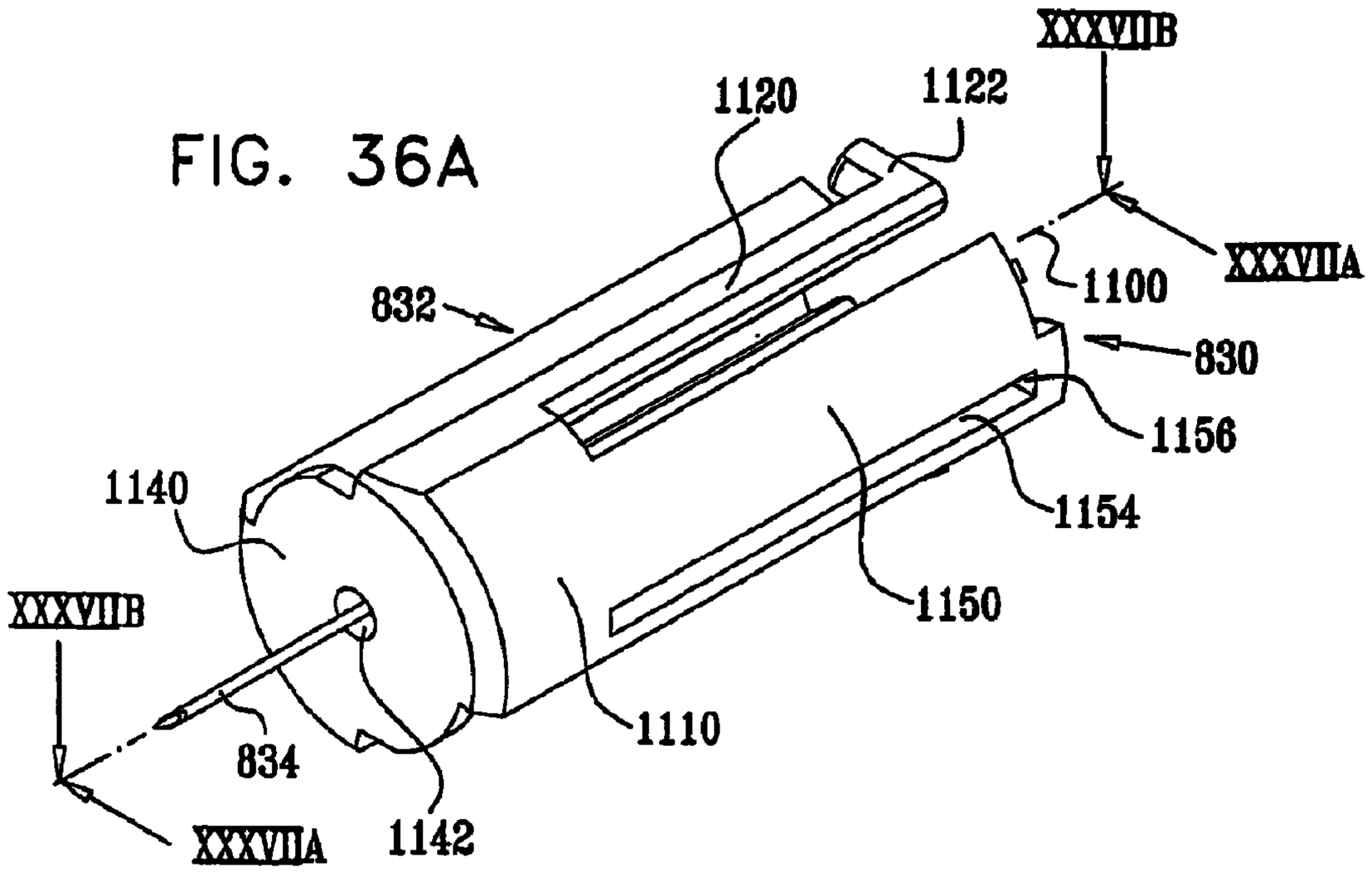


FIG. 36B

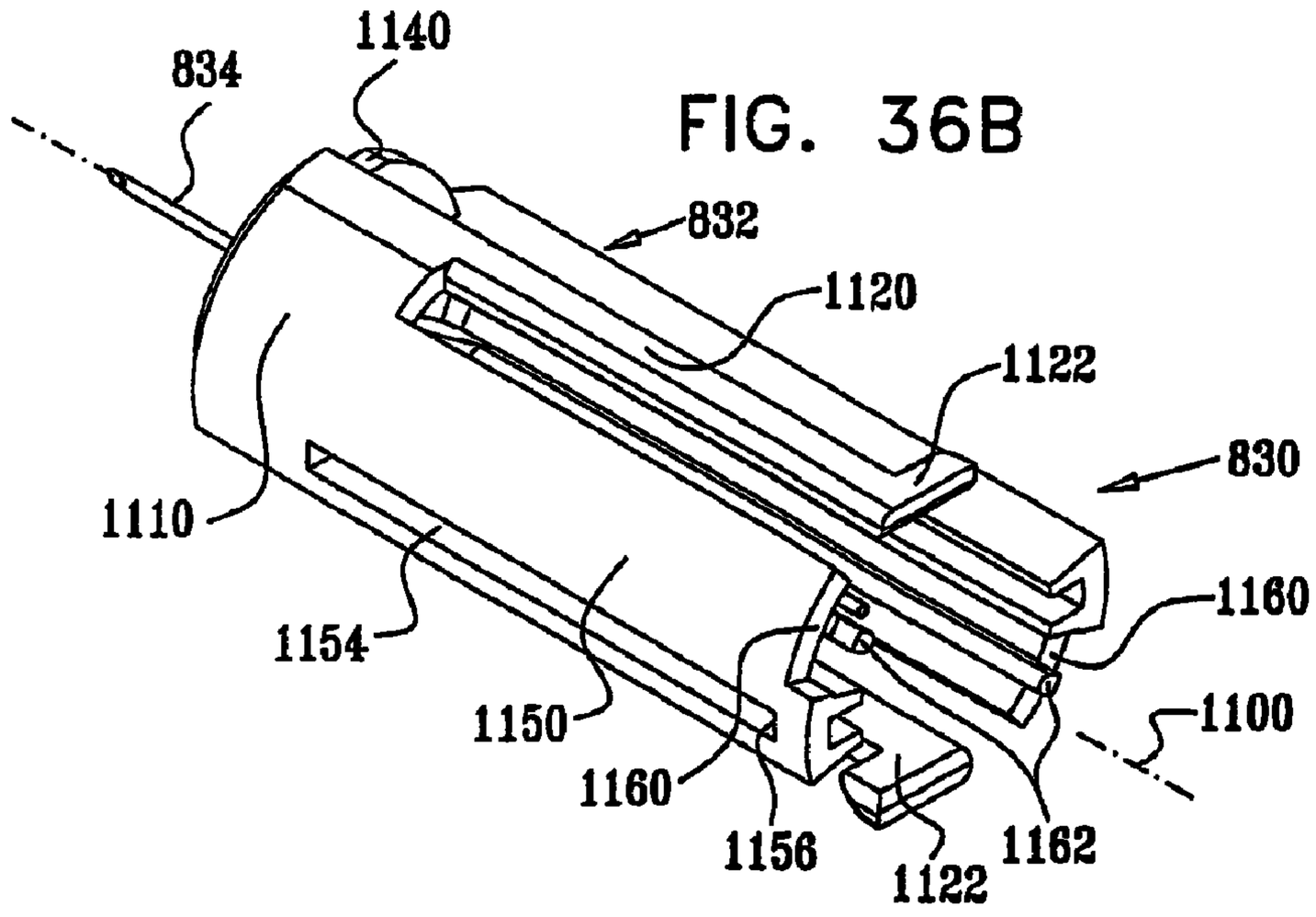


FIG. 37A

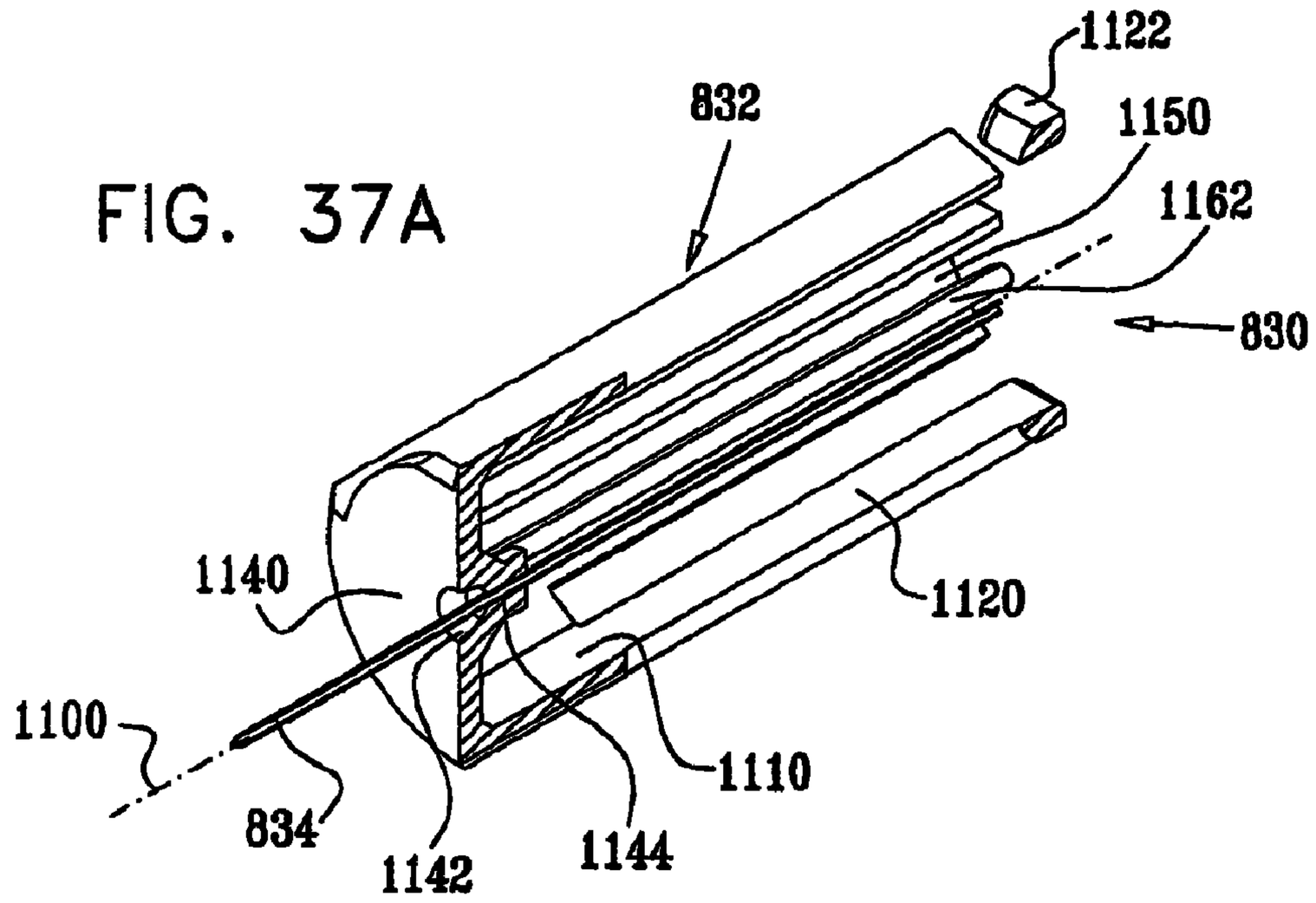


FIG. 37B

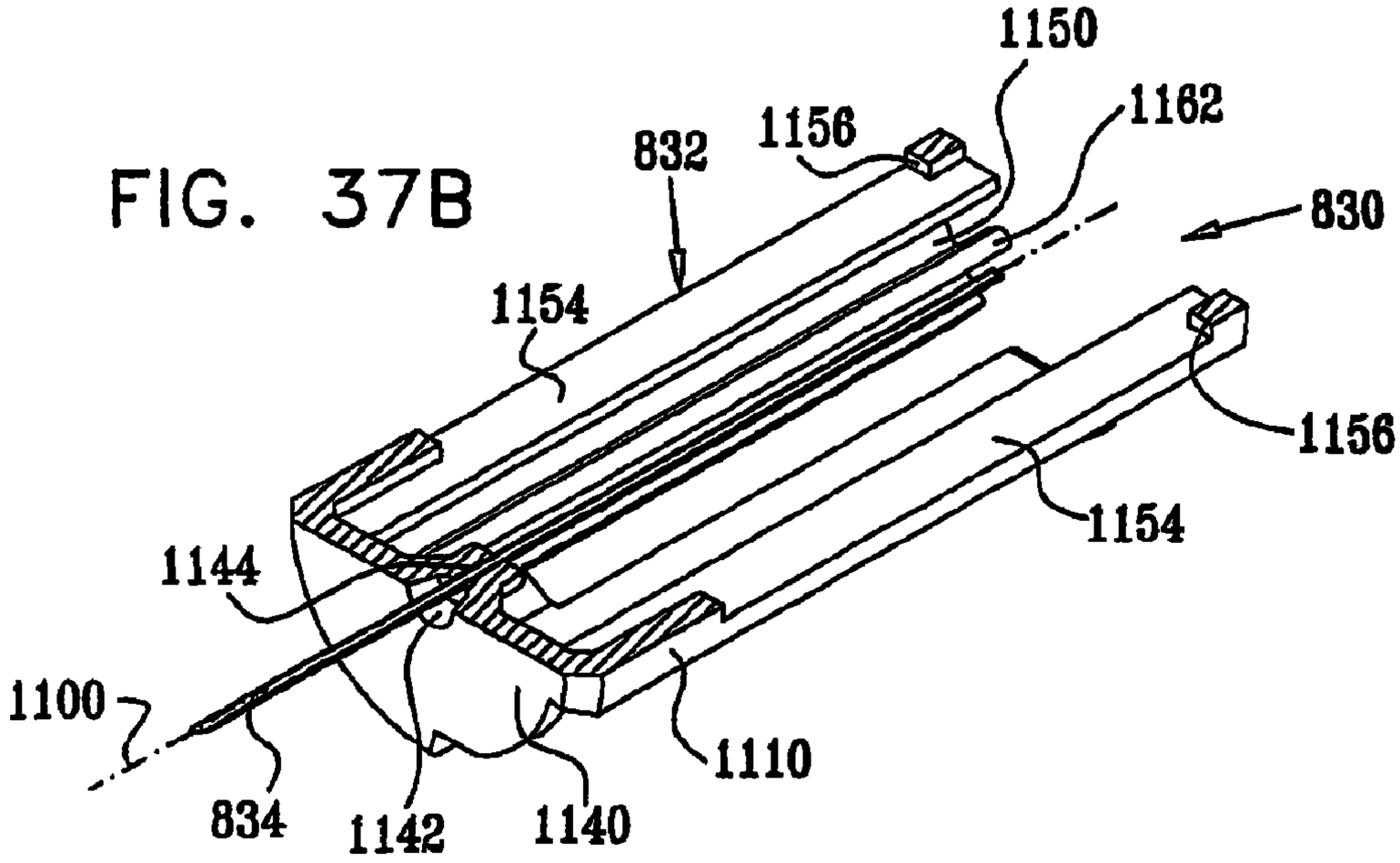


FIG. 38A

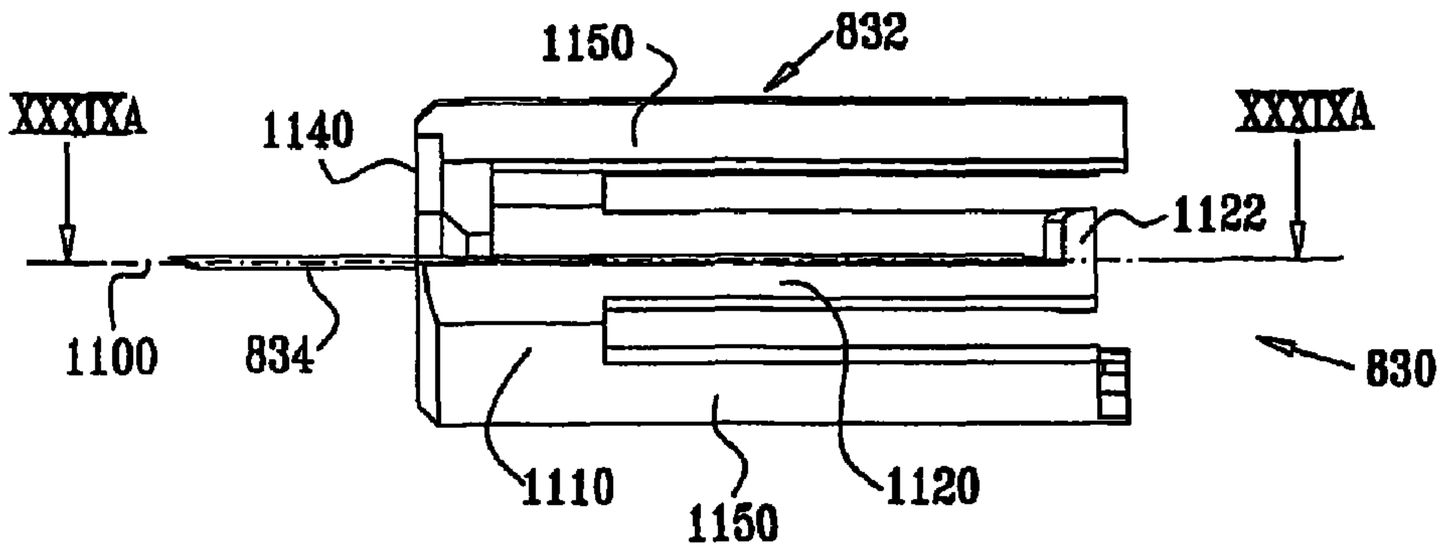


FIG. 38B

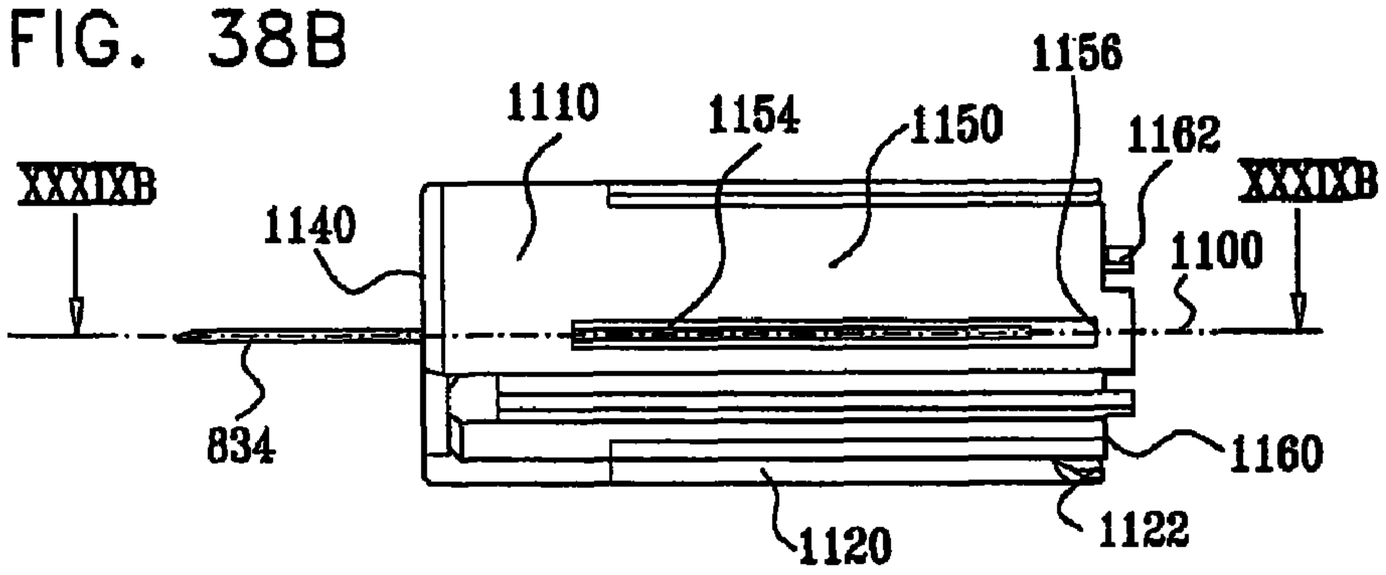


FIG. 39A

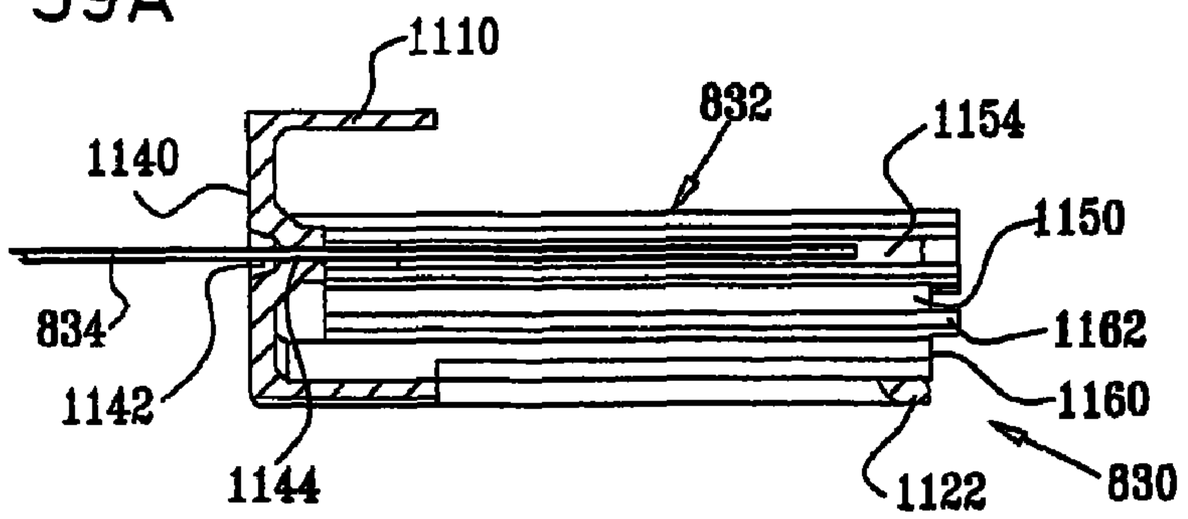


FIG. 39B

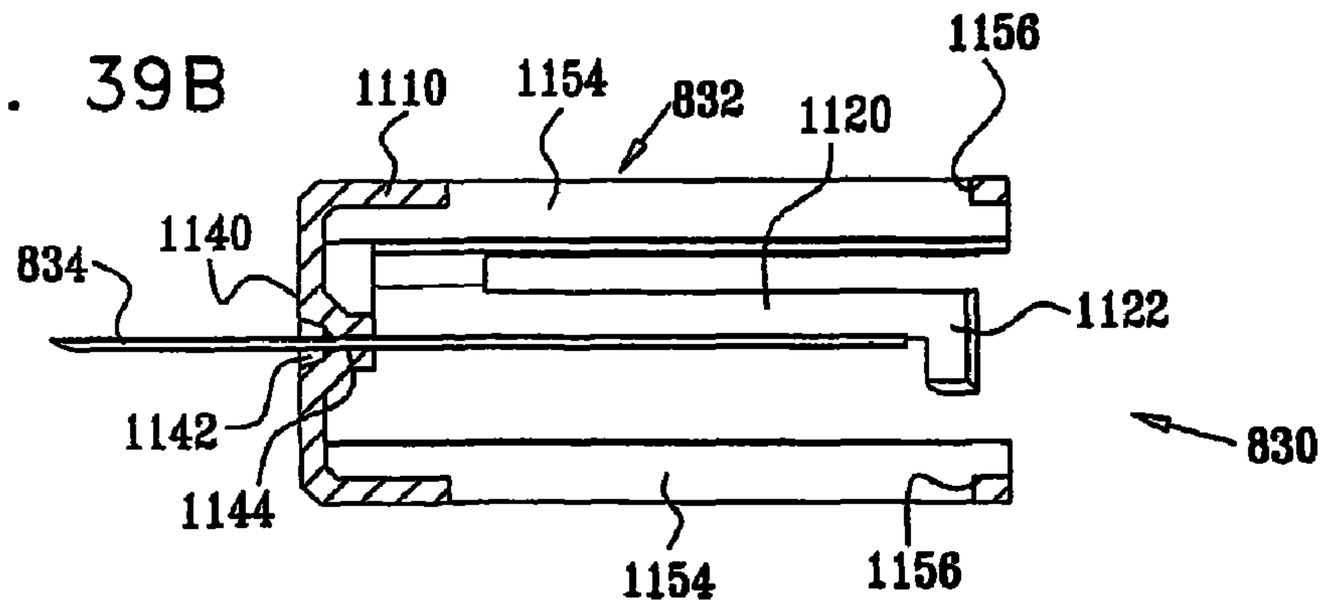


FIG. 40A

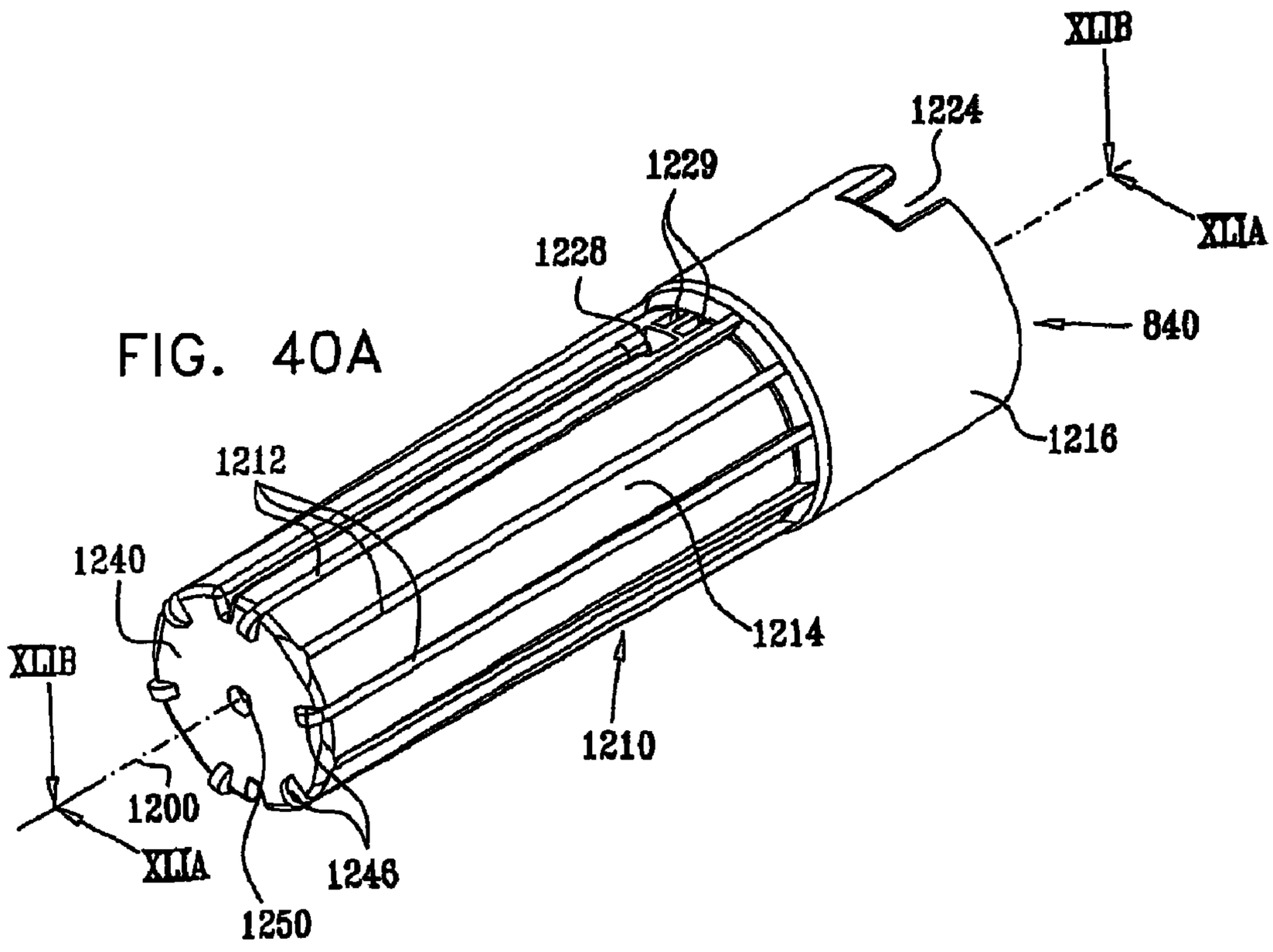


FIG. 40B

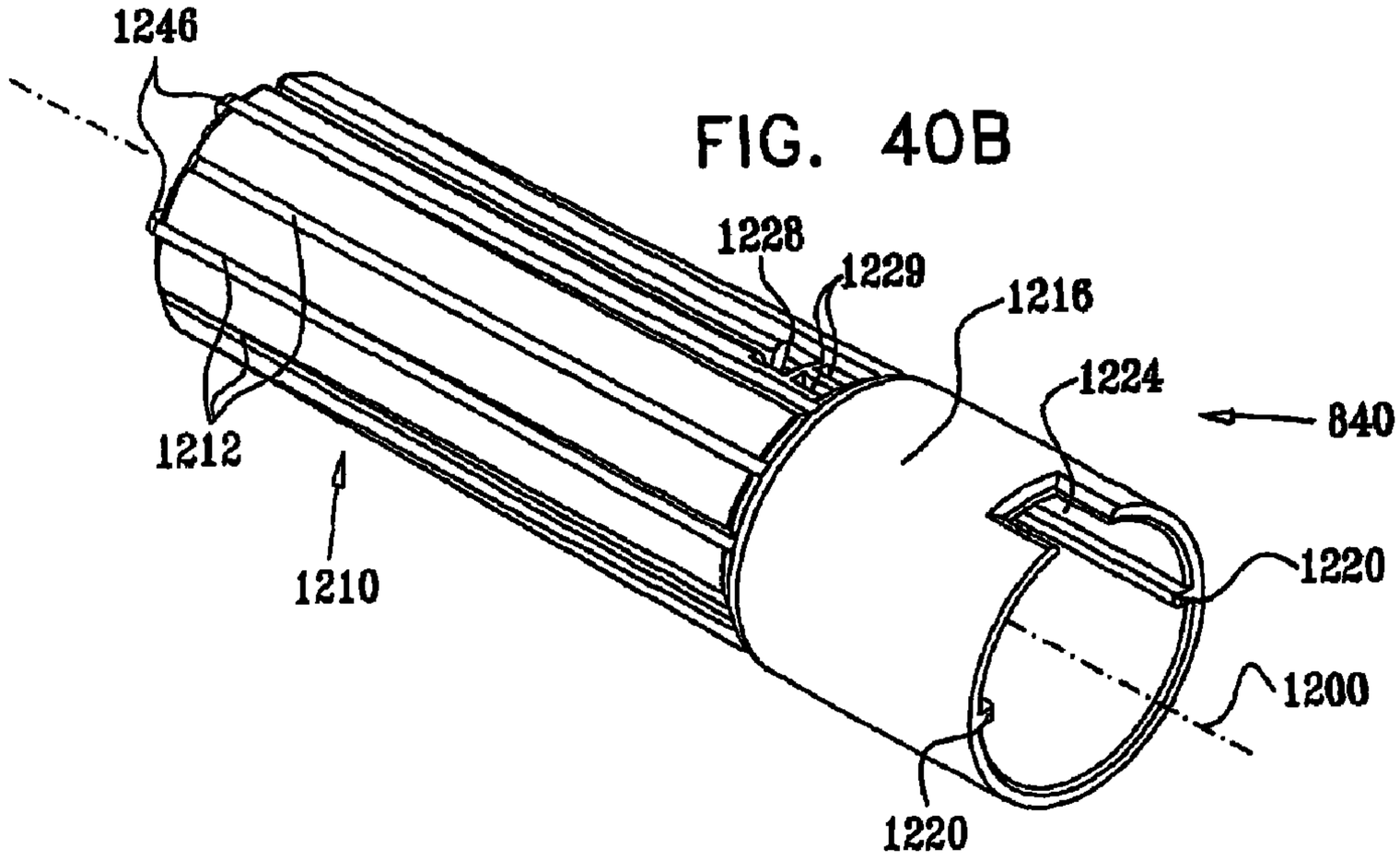


FIG. 41A

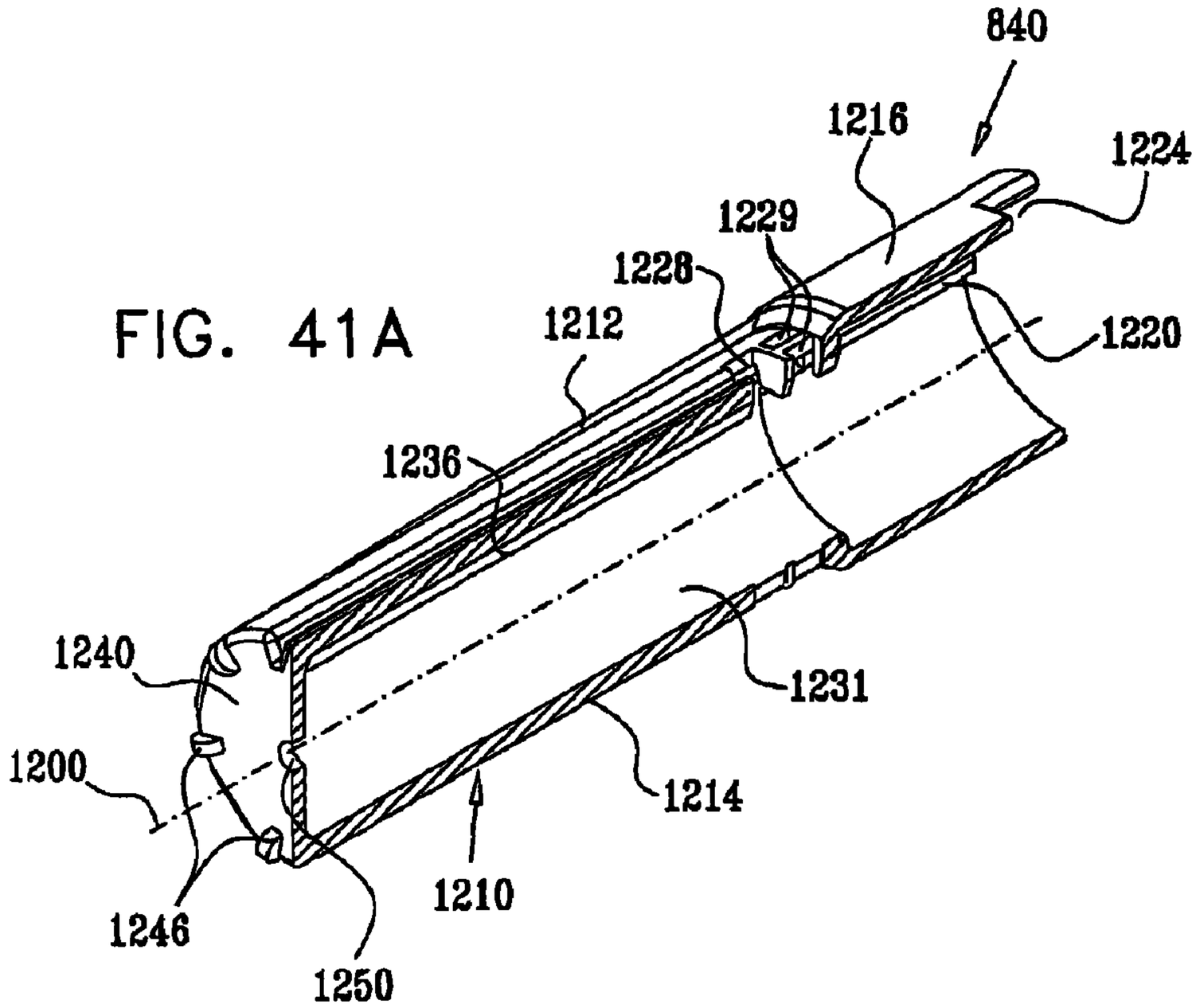


FIG. 41B

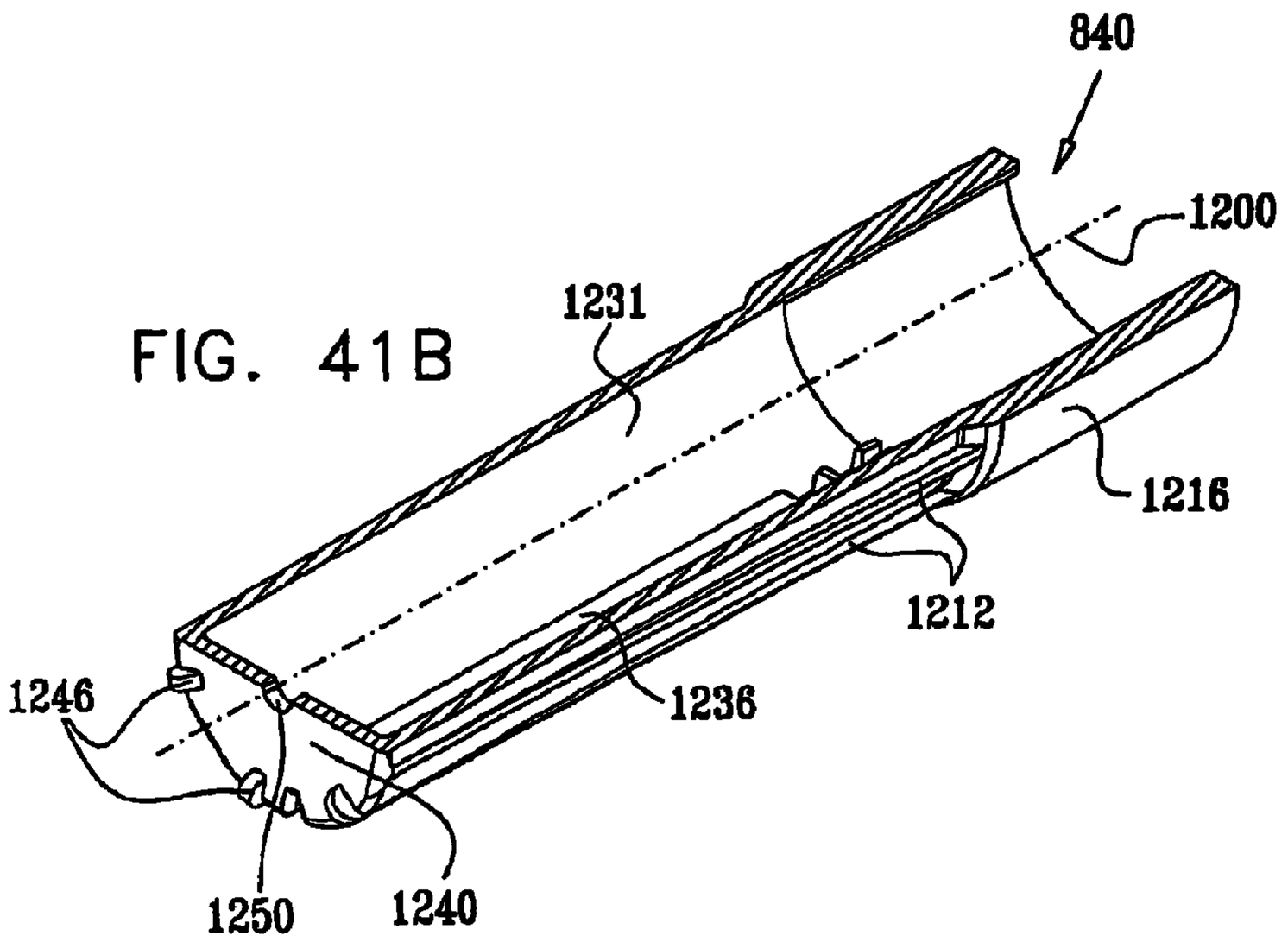


FIG. 42A

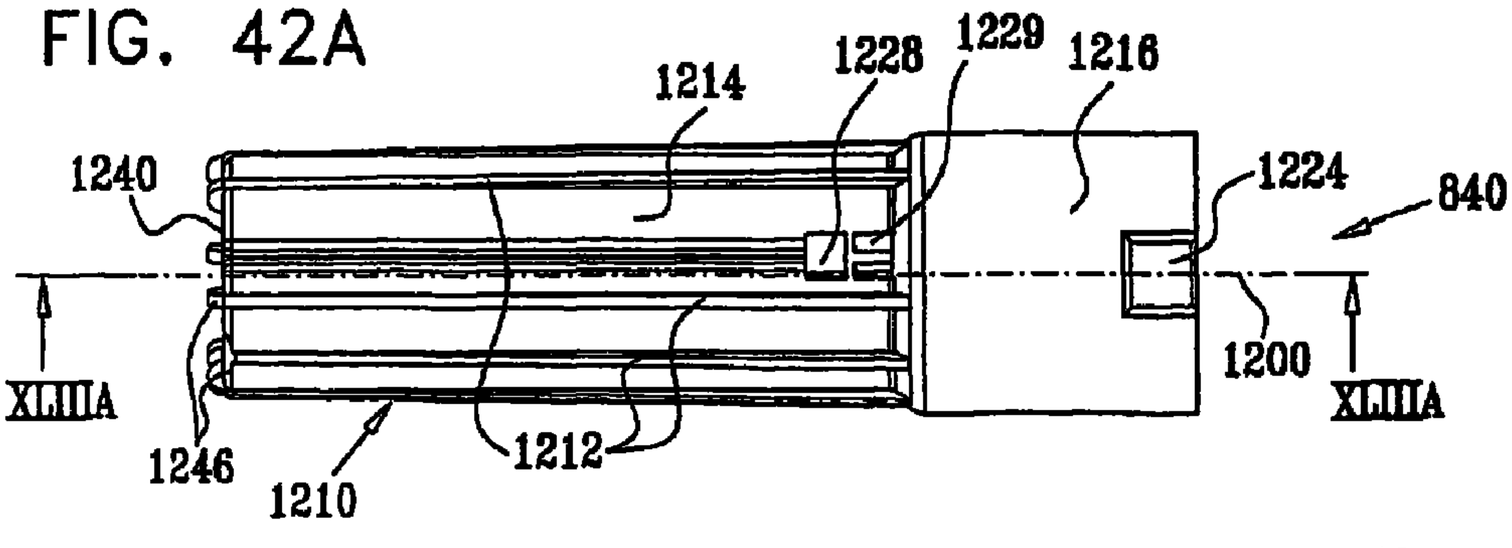


FIG. 42B

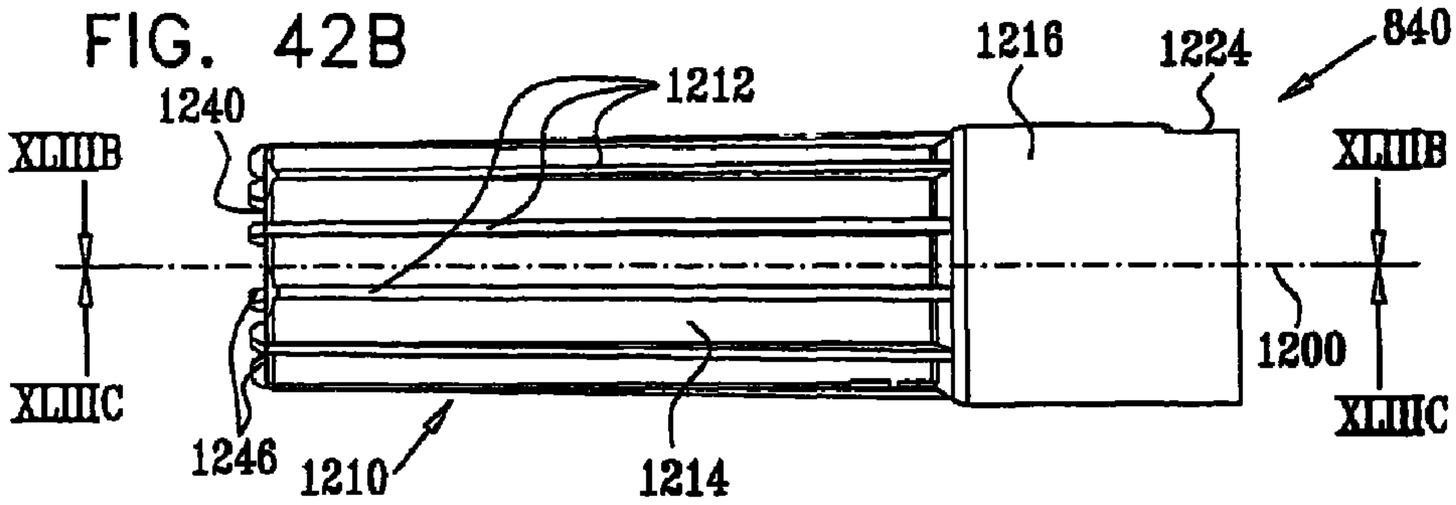


FIG. 43A

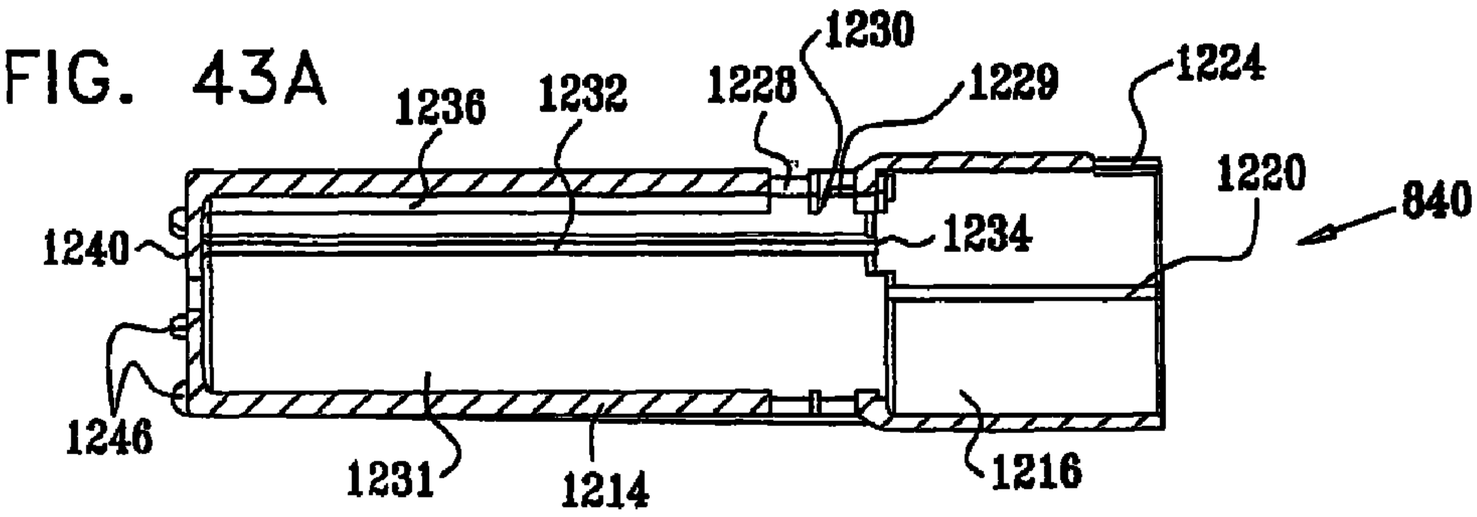


FIG. 43B

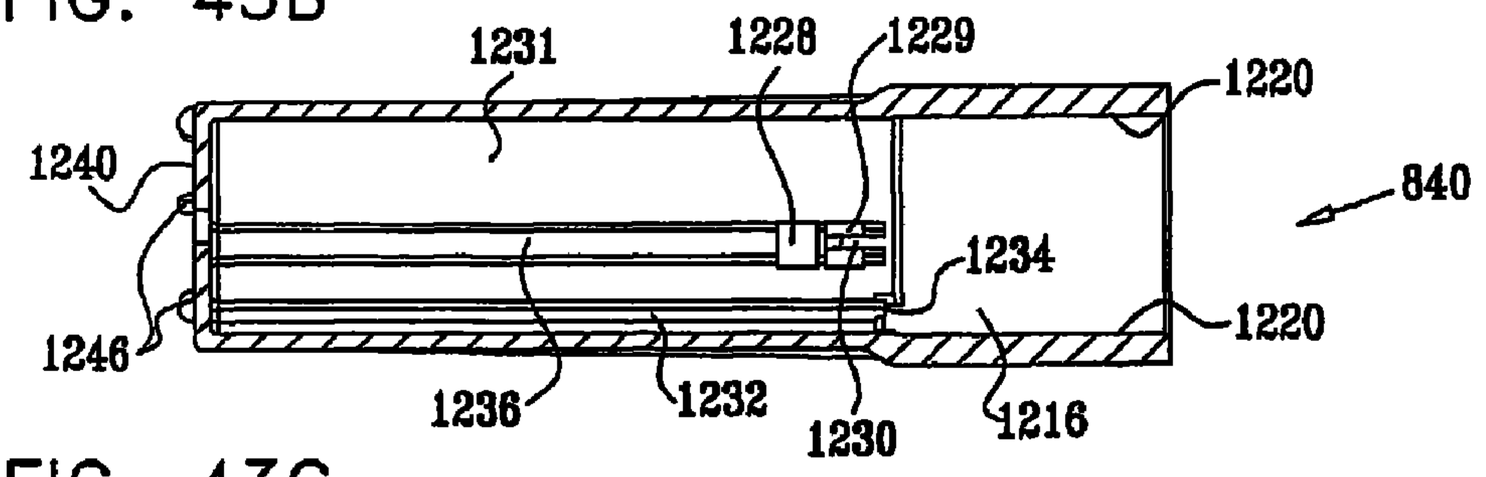
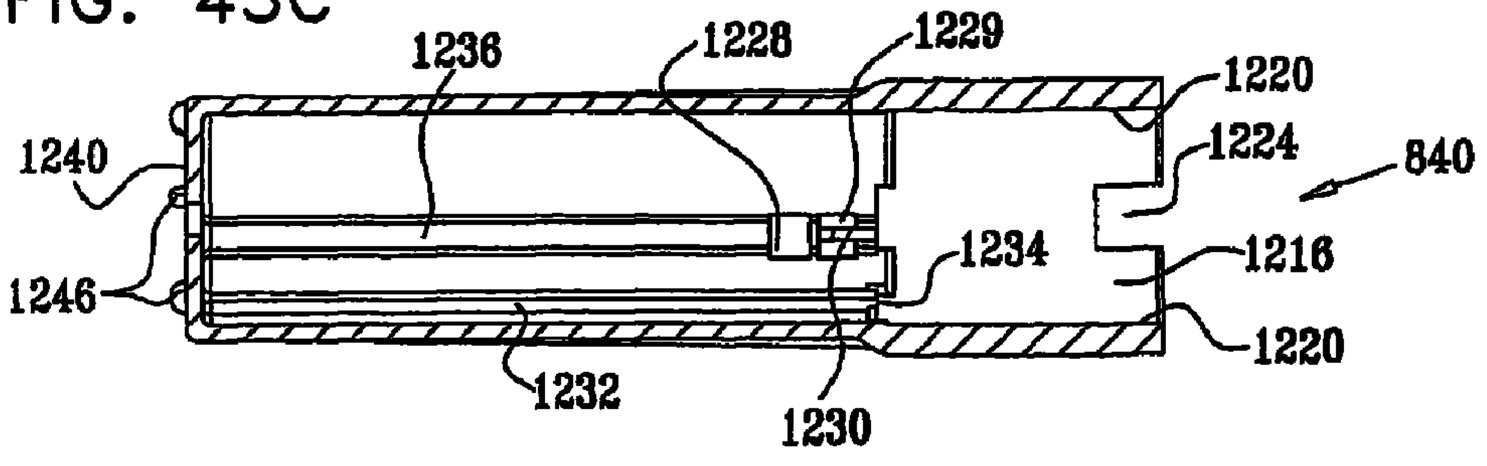


FIG. 43C



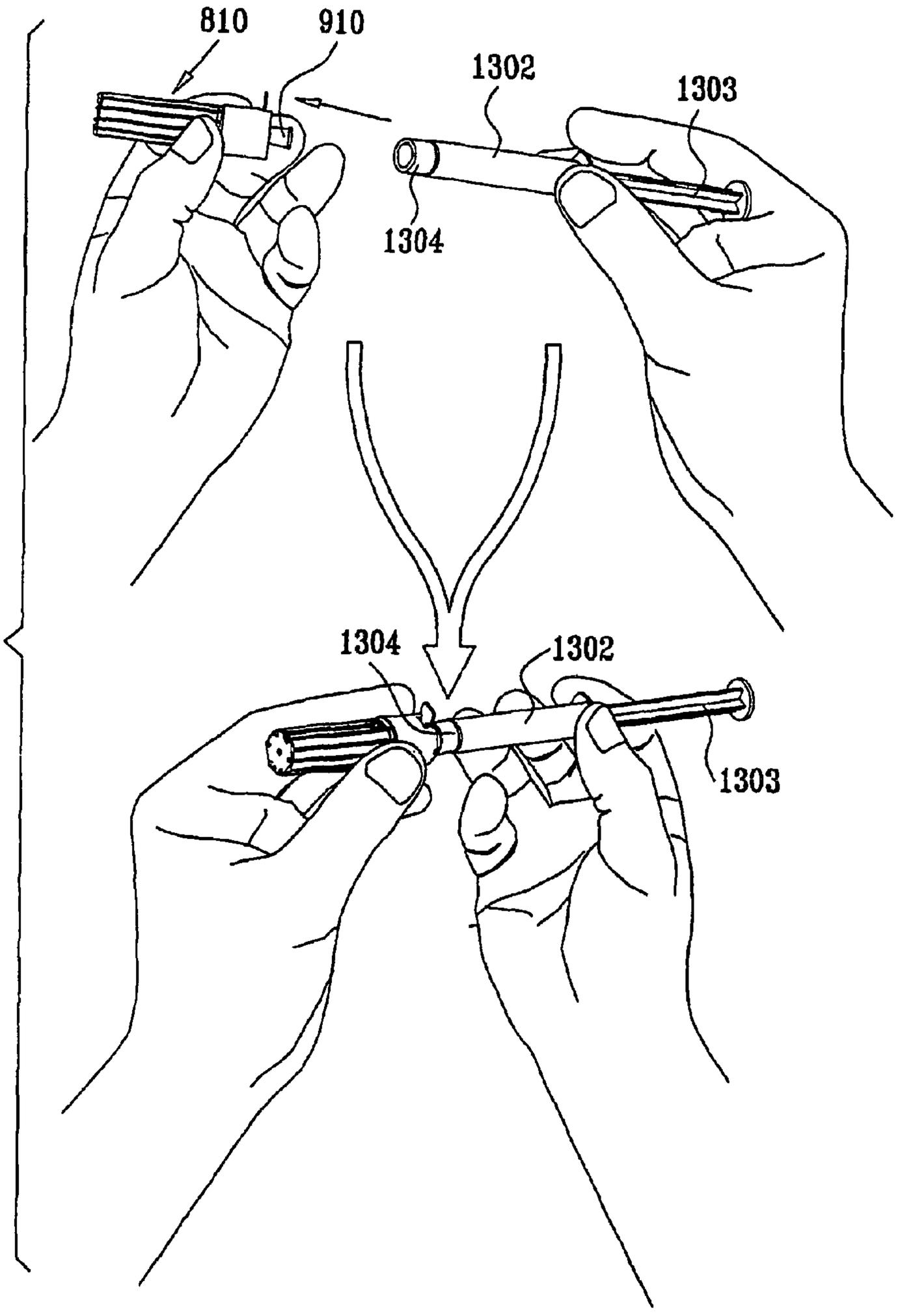
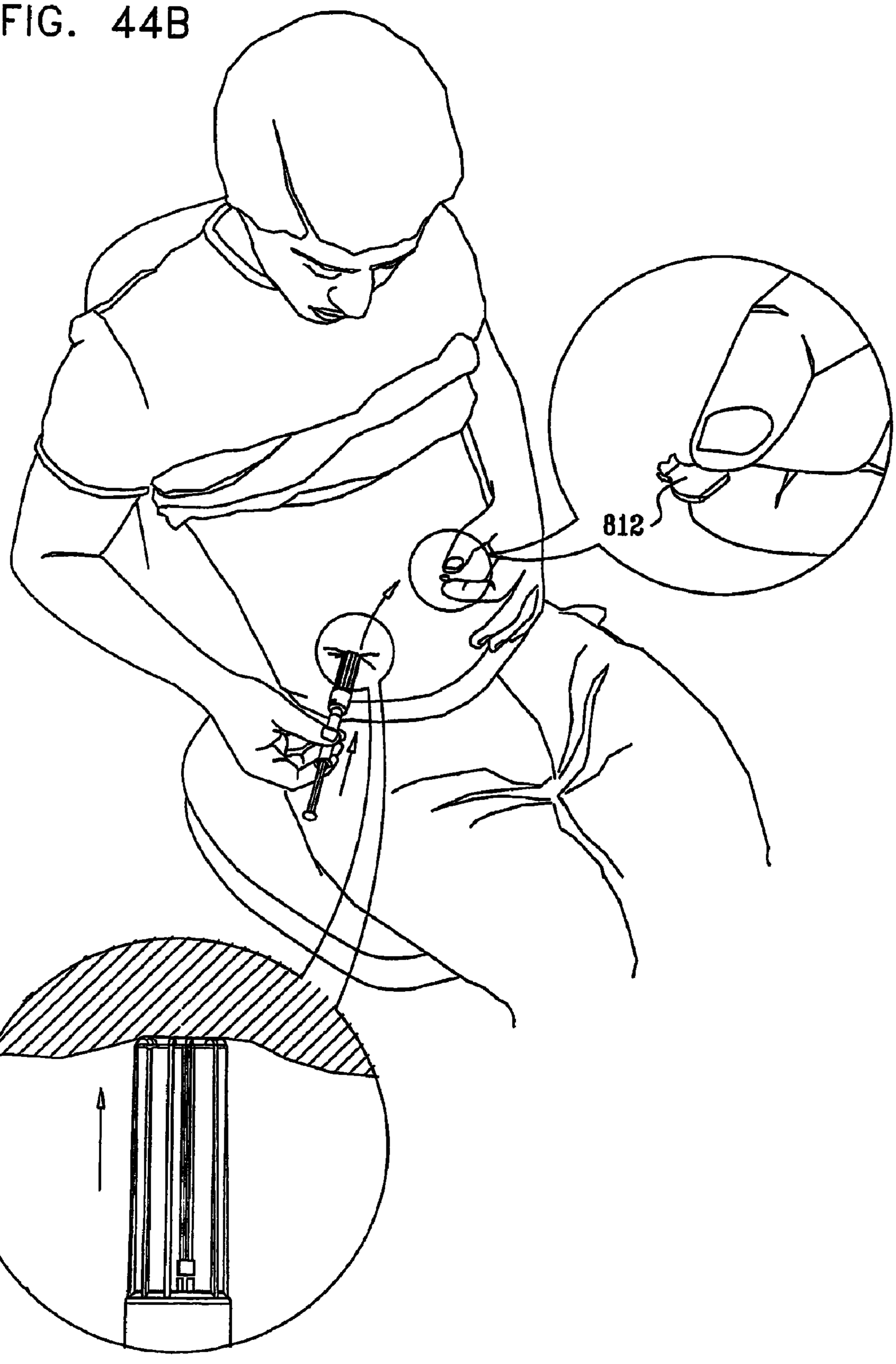


FIG. 44A

FIG. 44B



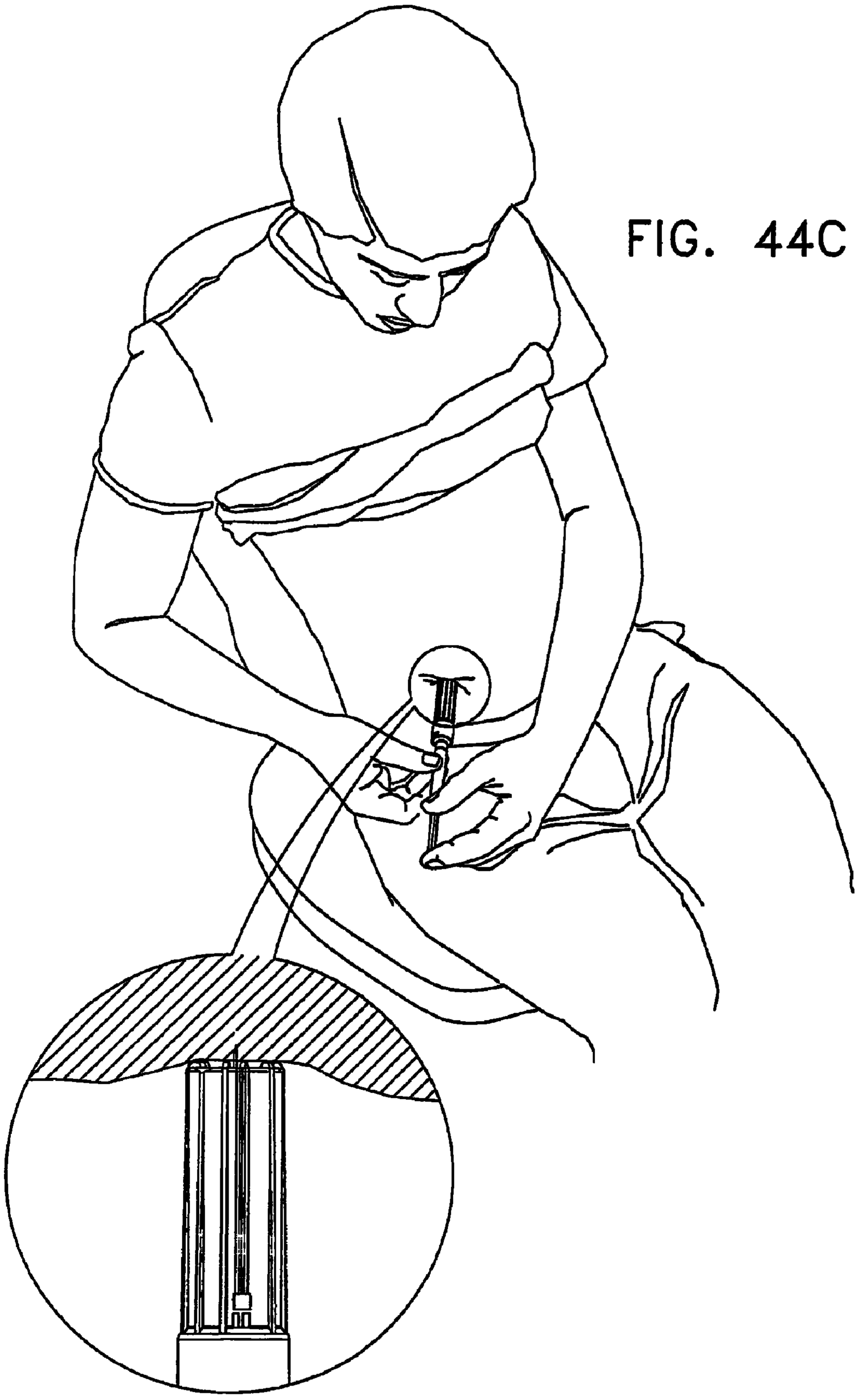


FIG. 44C

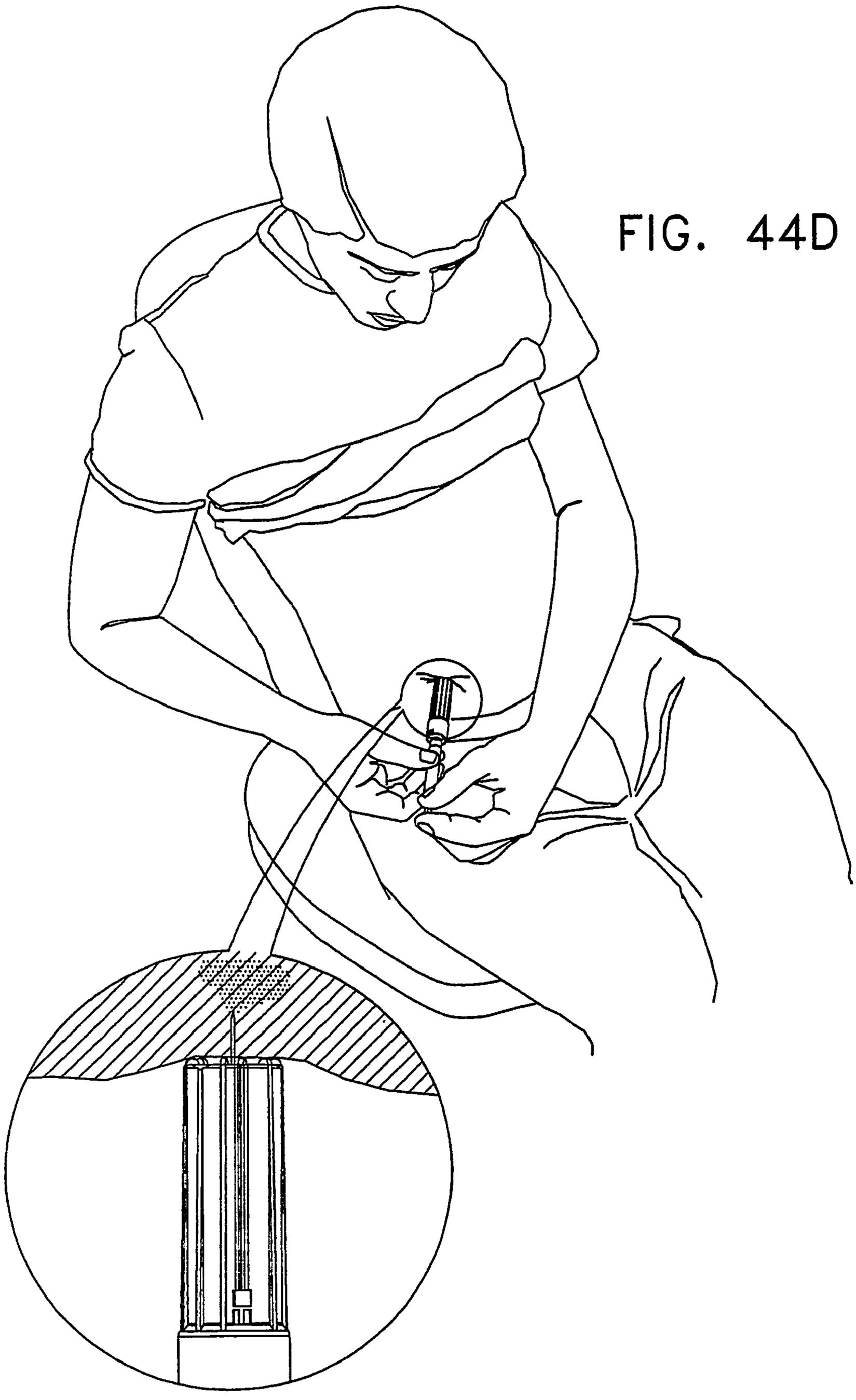


FIG. 44D

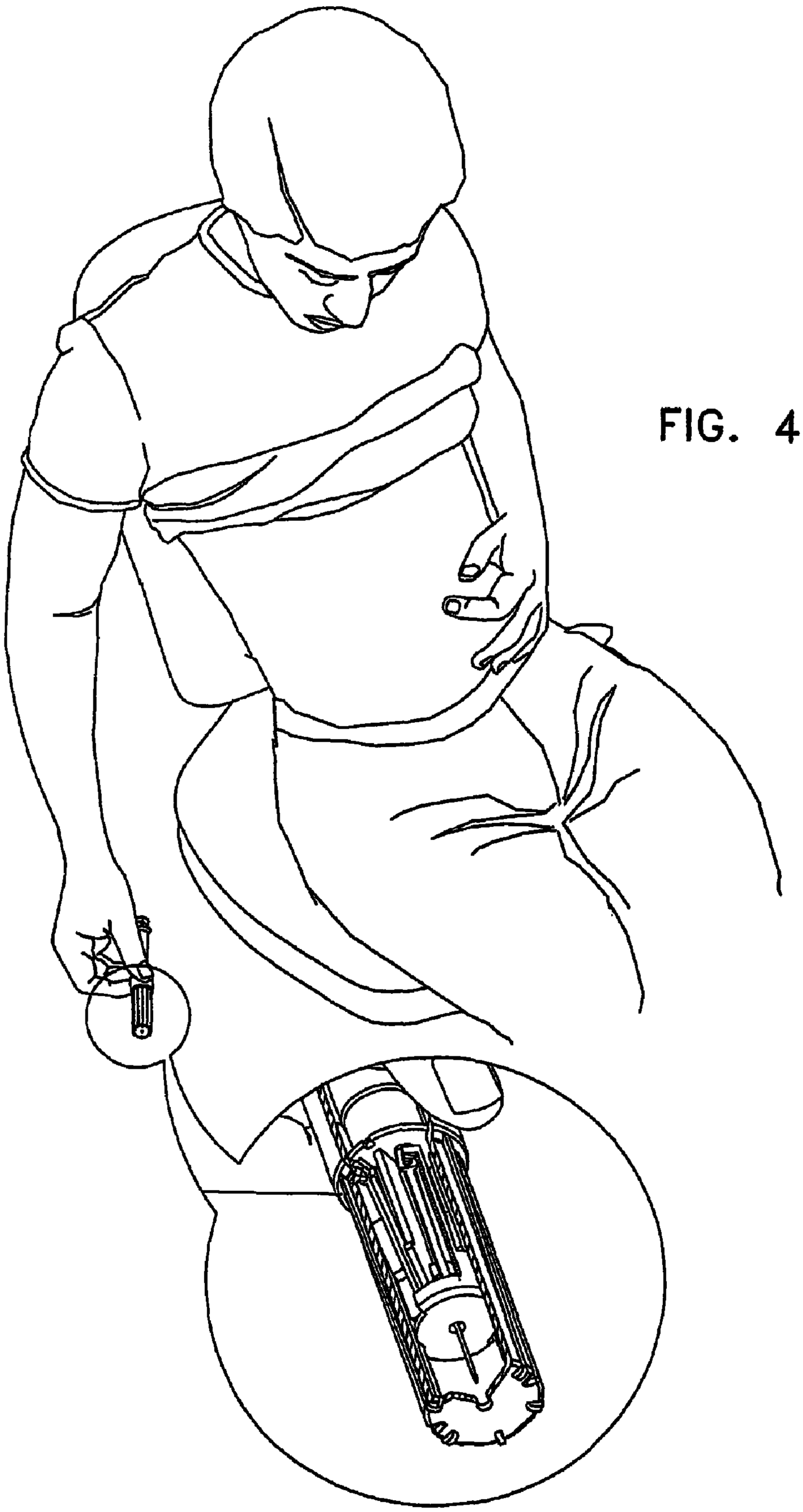


FIG. 44E

FIG. 44F

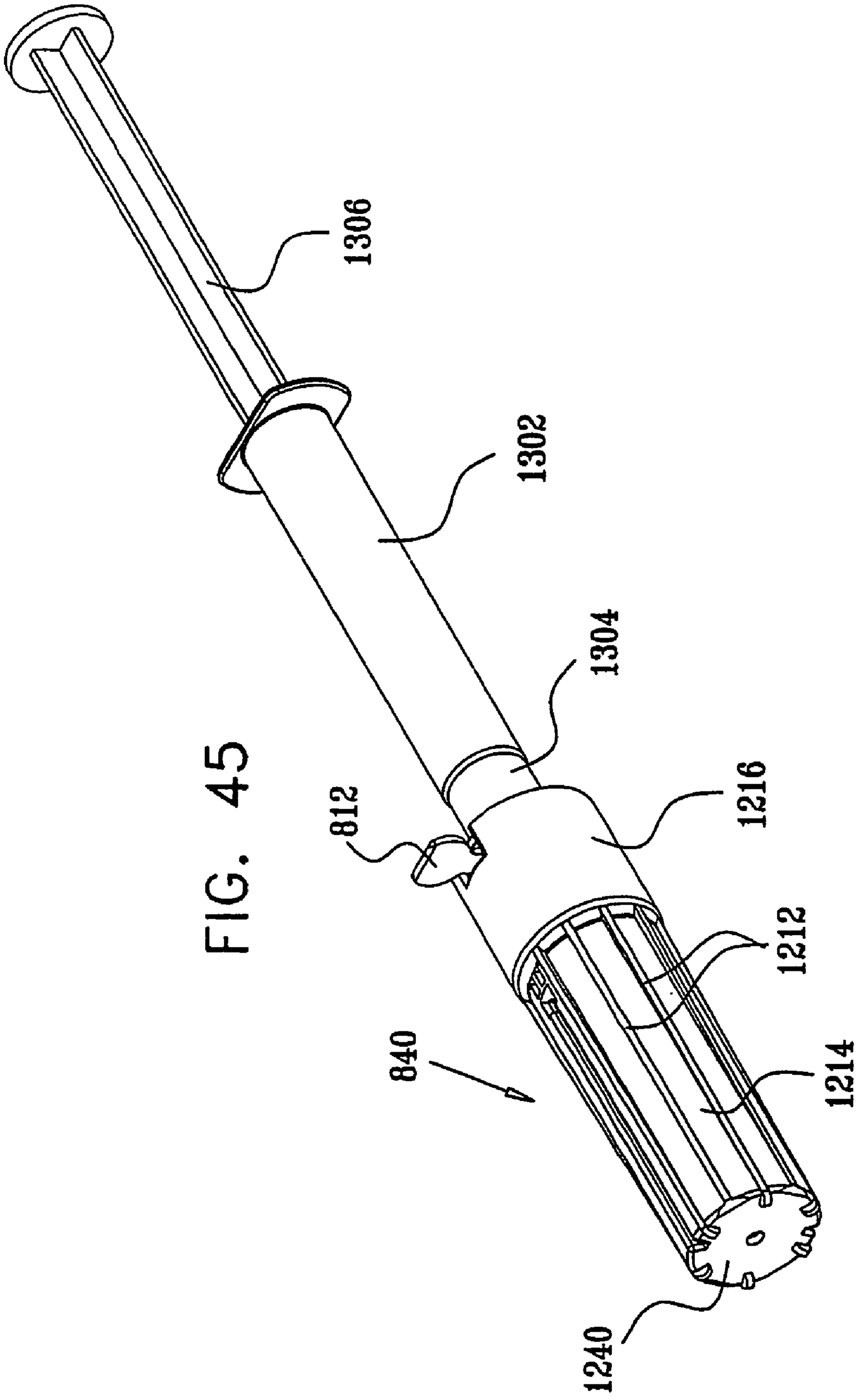


FIG. 45

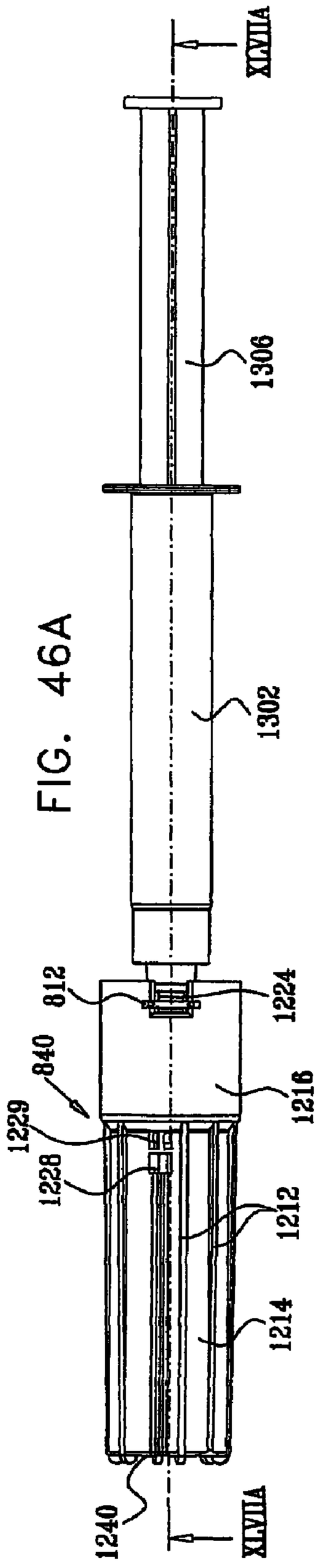


FIG. 46A

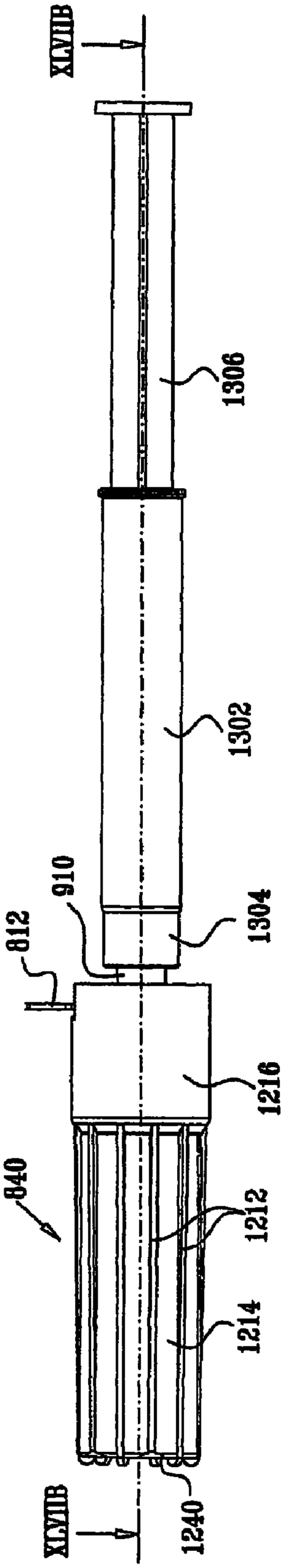


FIG. 46B

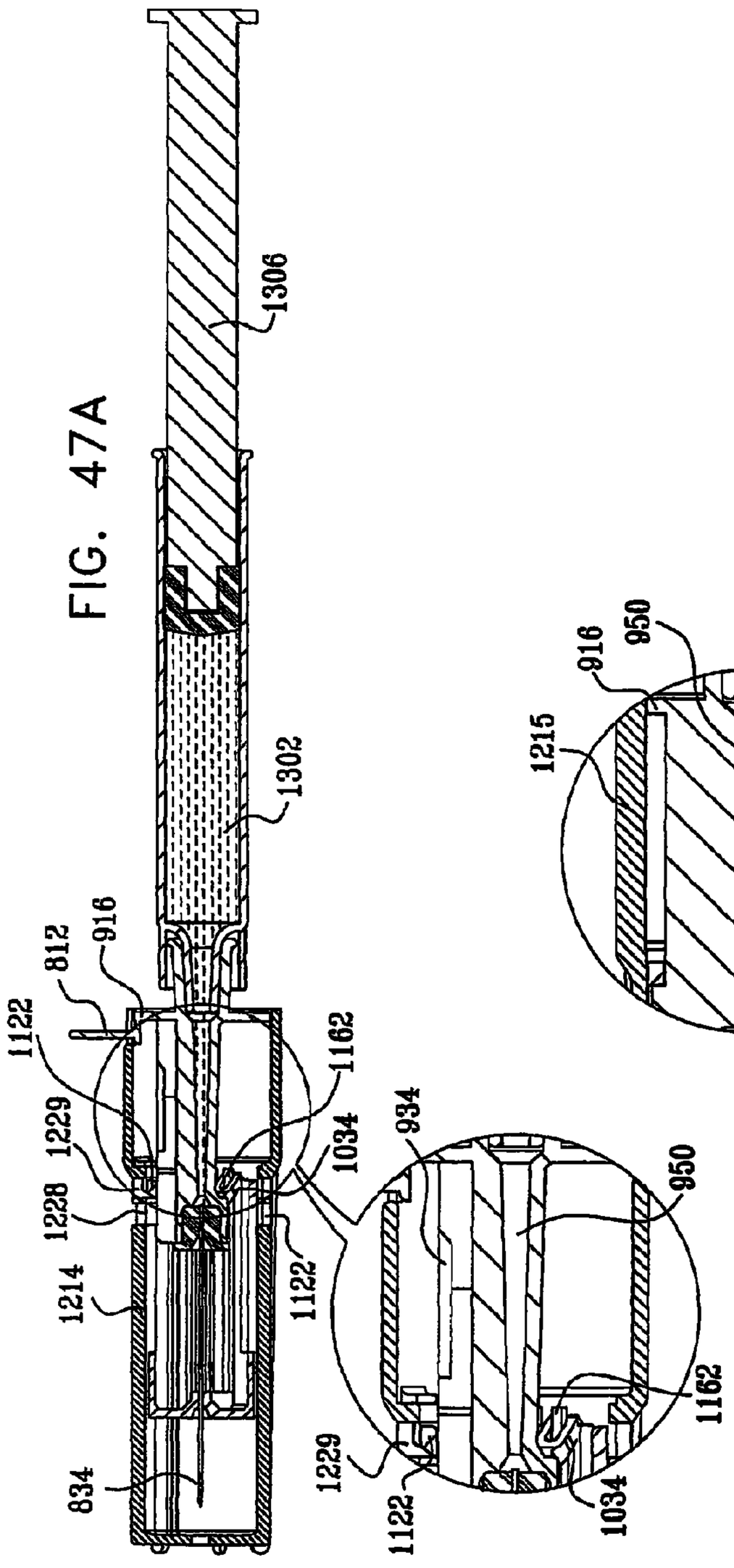


FIG. 47A

FIG. 47B

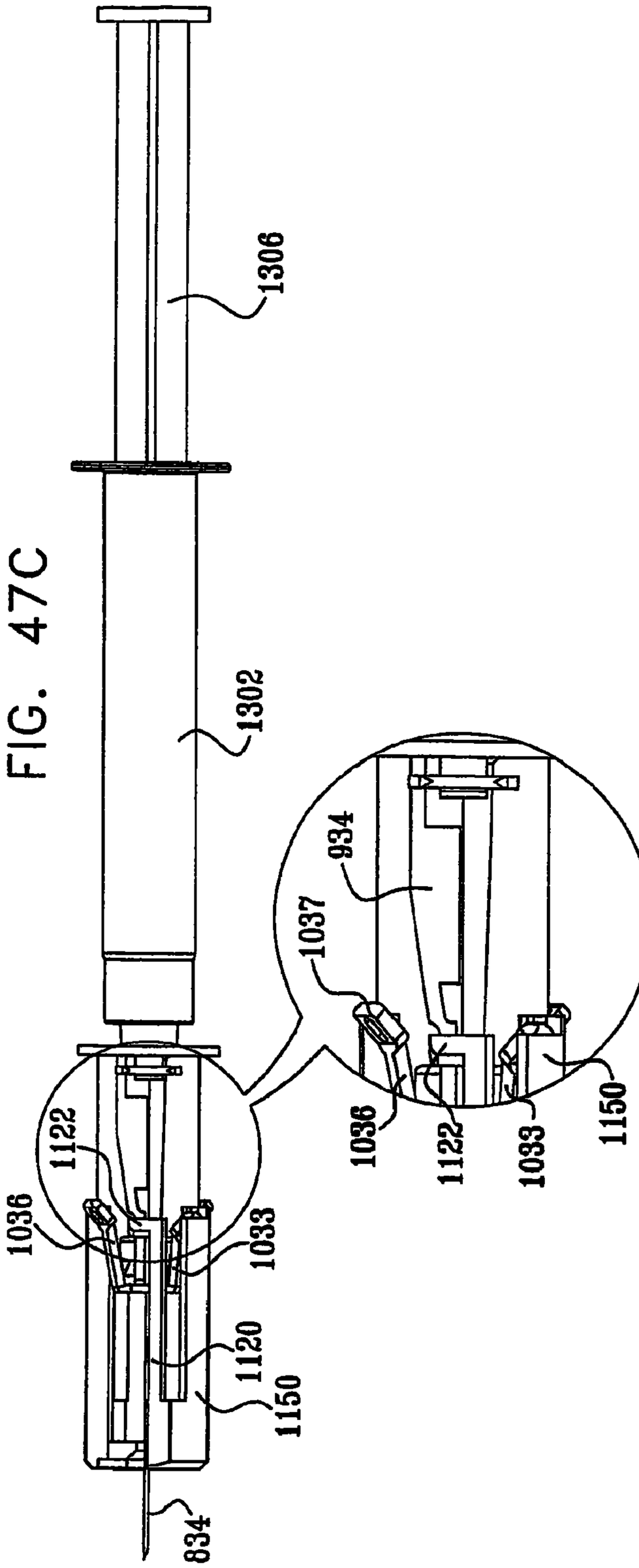


FIG. 47C

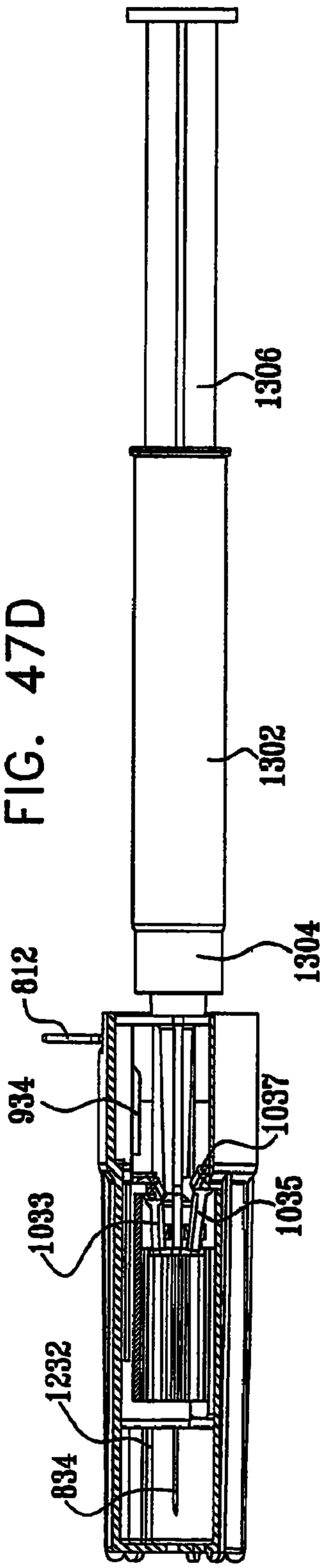


FIG. 47D

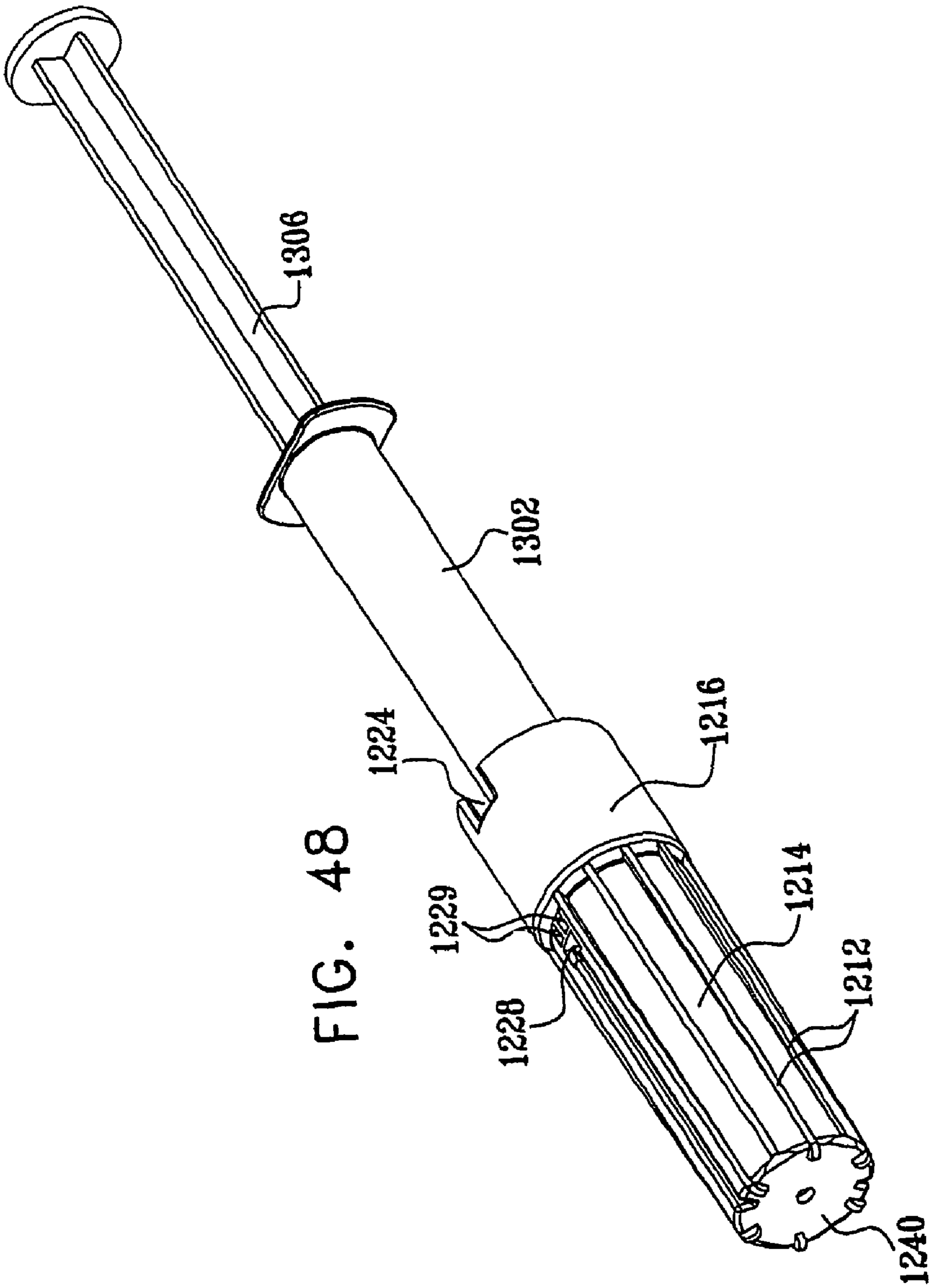


FIG. 48

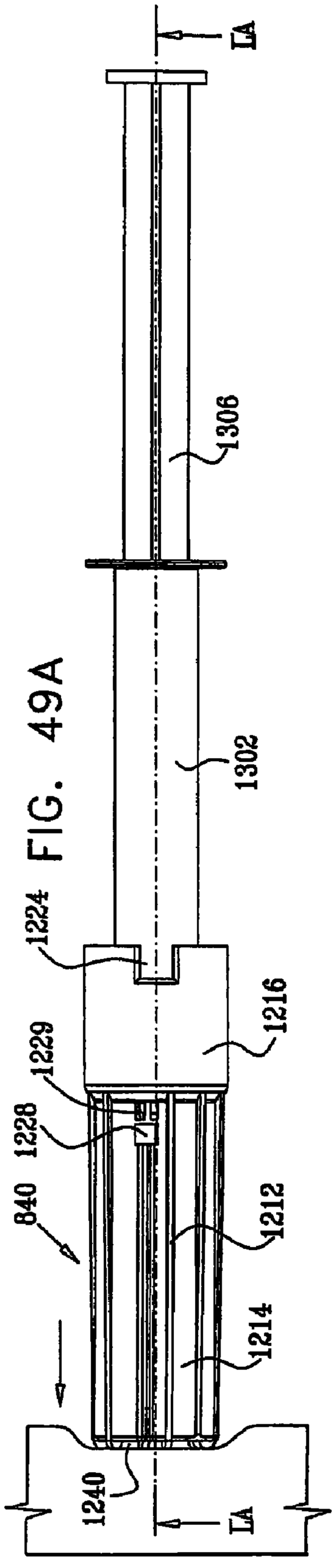


FIG. 49A

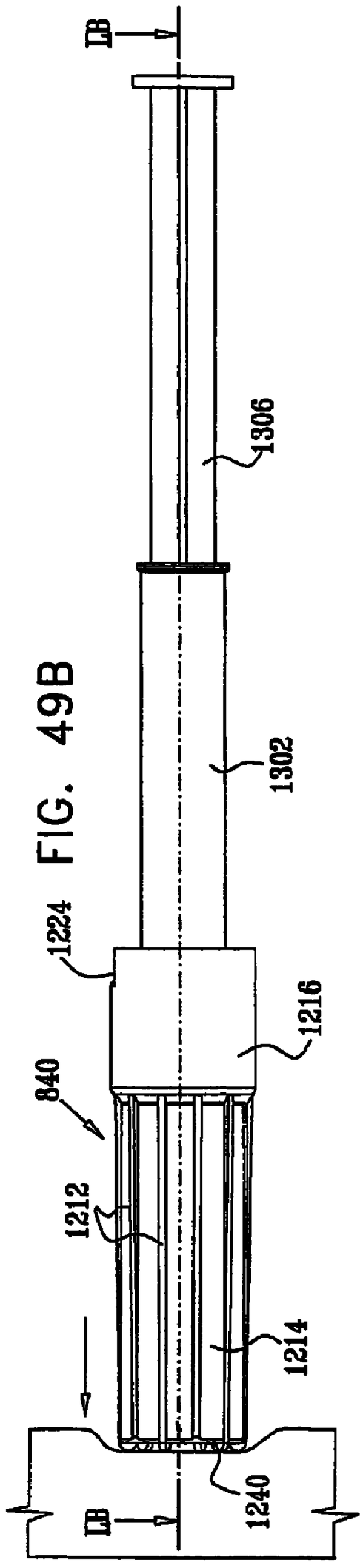


FIG. 49B

FIG. 50A

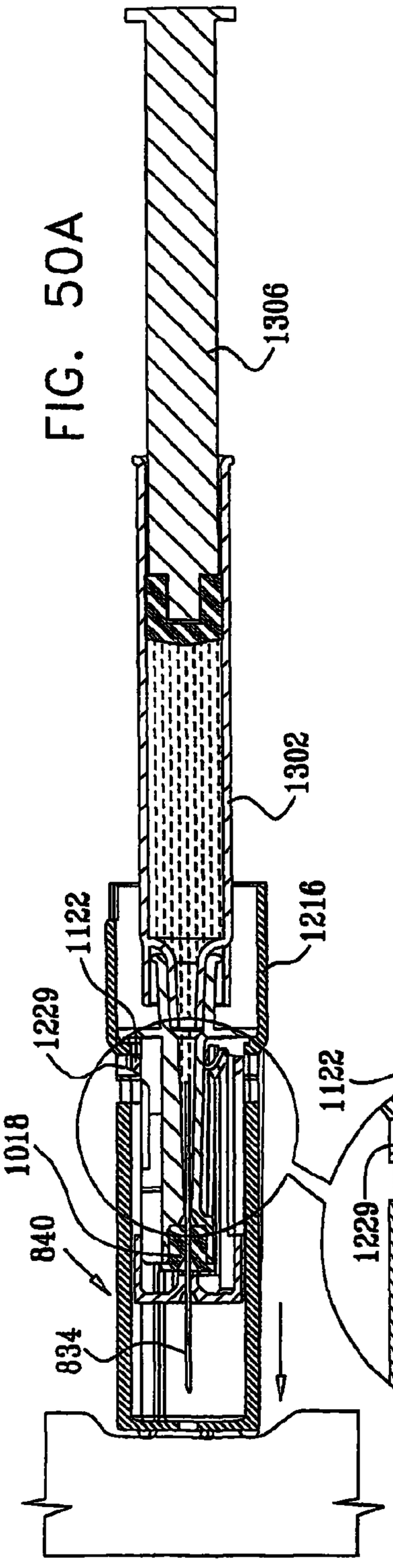


FIG. 50B

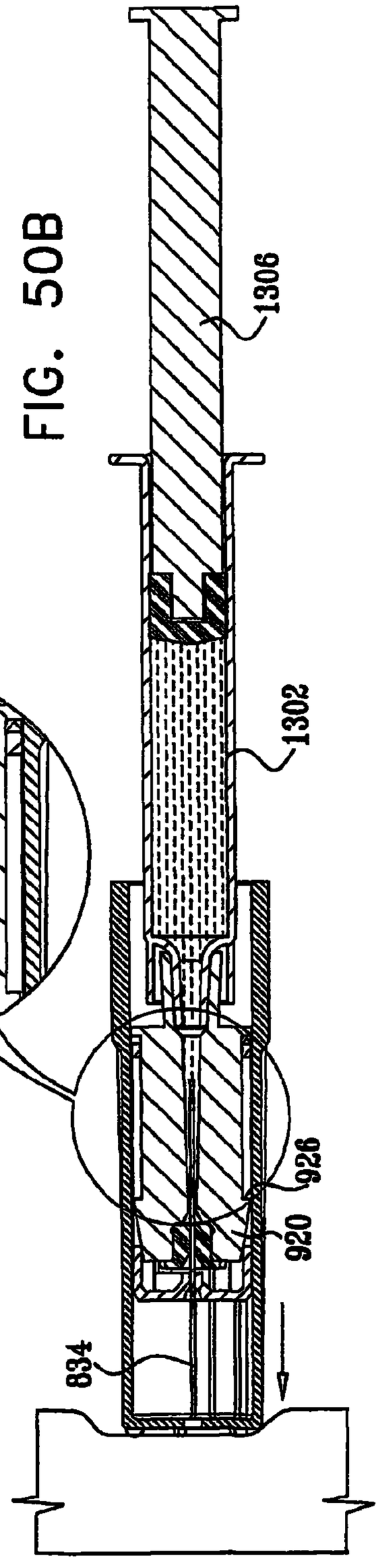


FIG. 50C

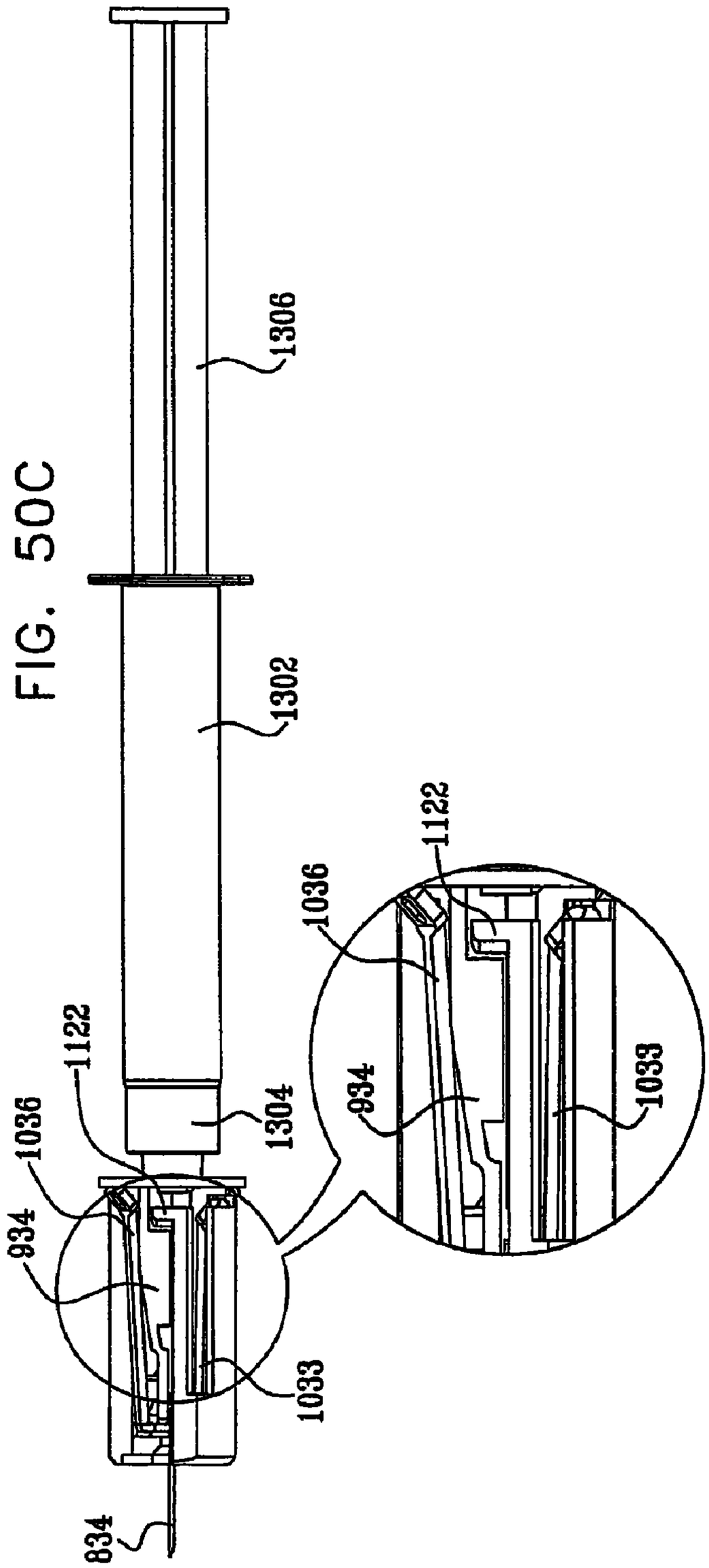
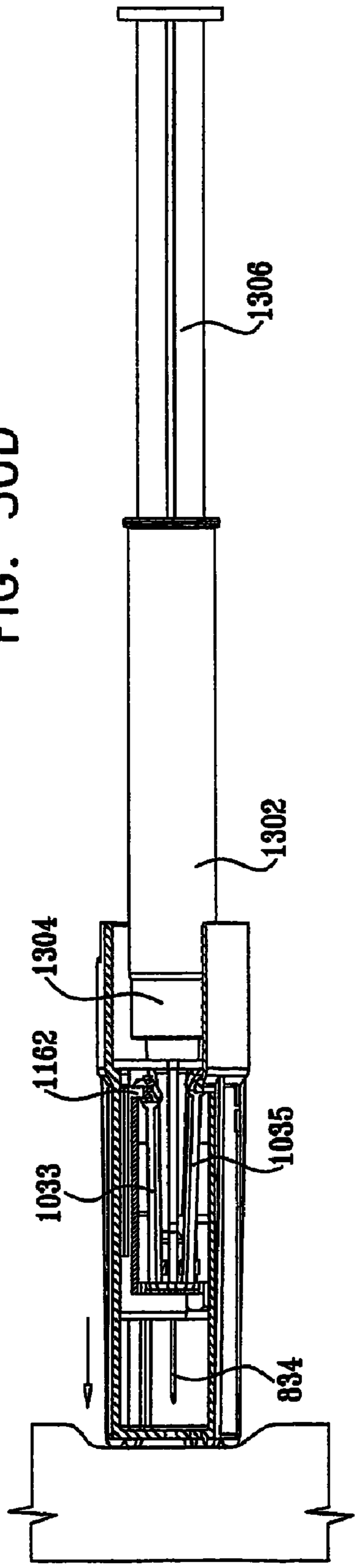


FIG. 50D



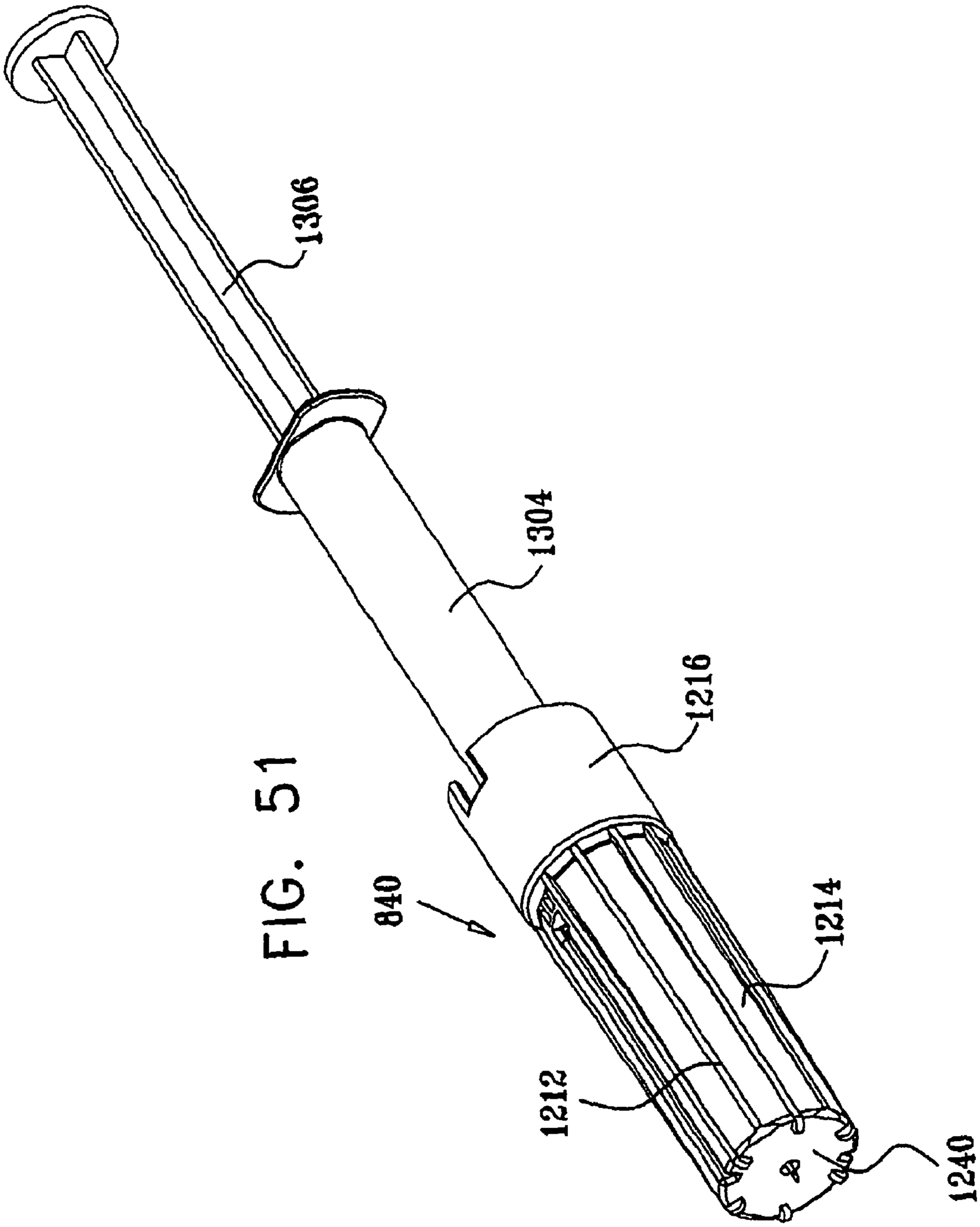


FIG. 51

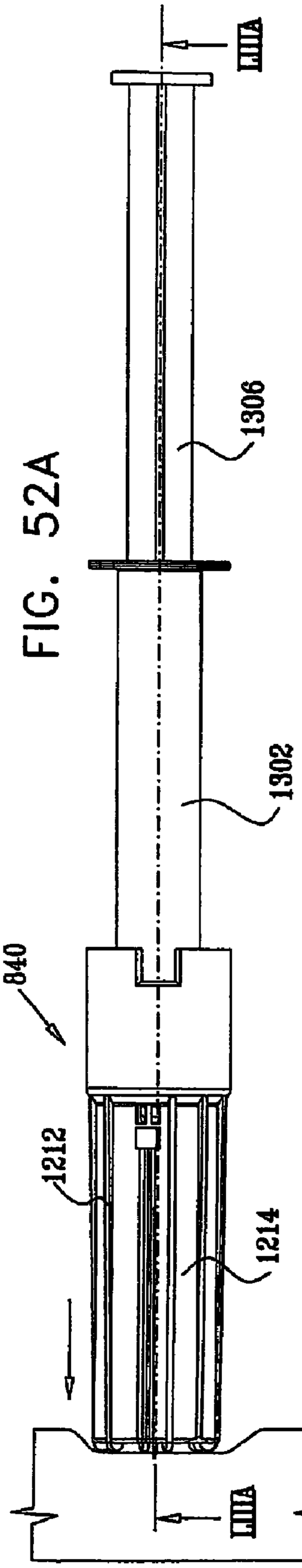


FIG. 52A

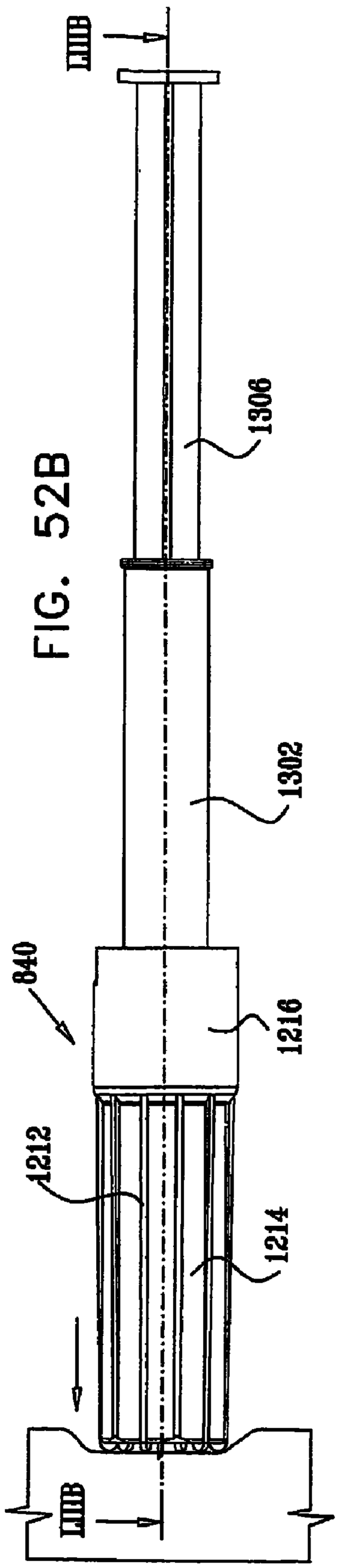


FIG. 52B

FIG. 53A

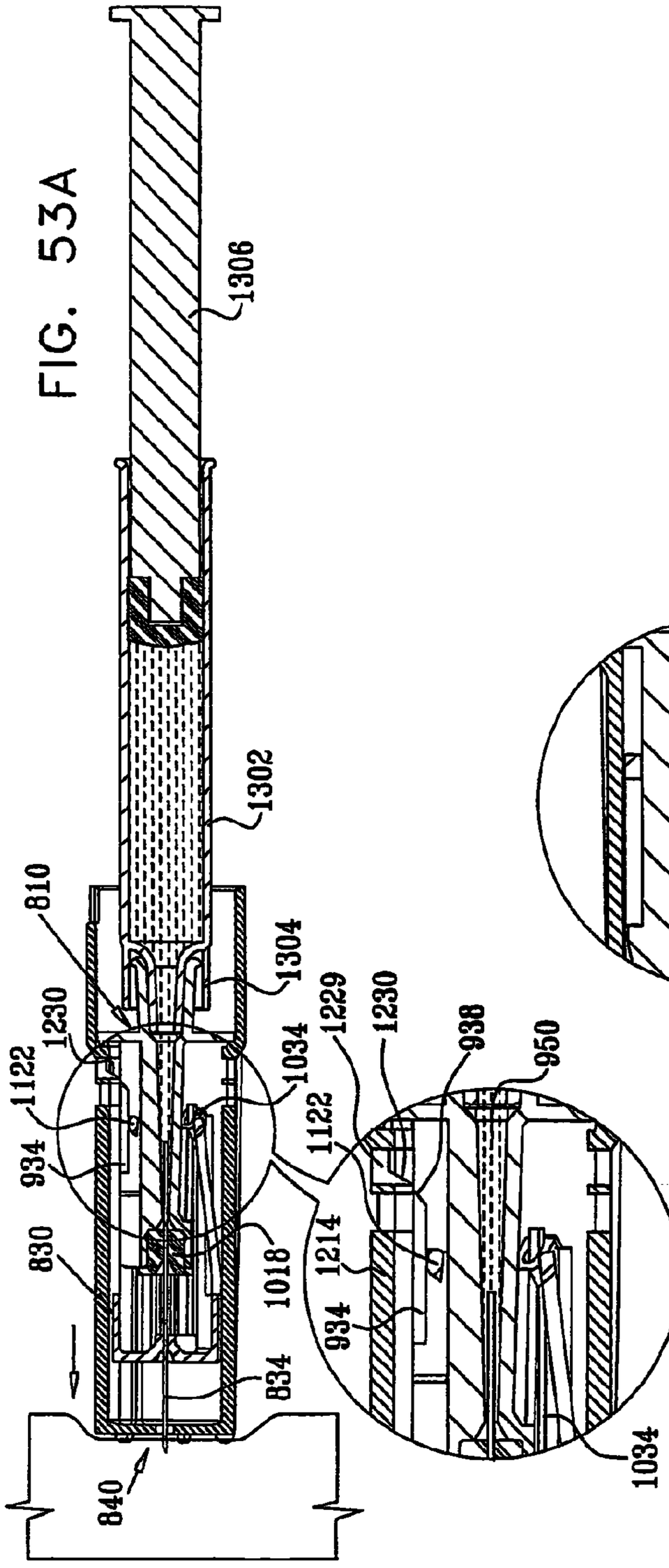
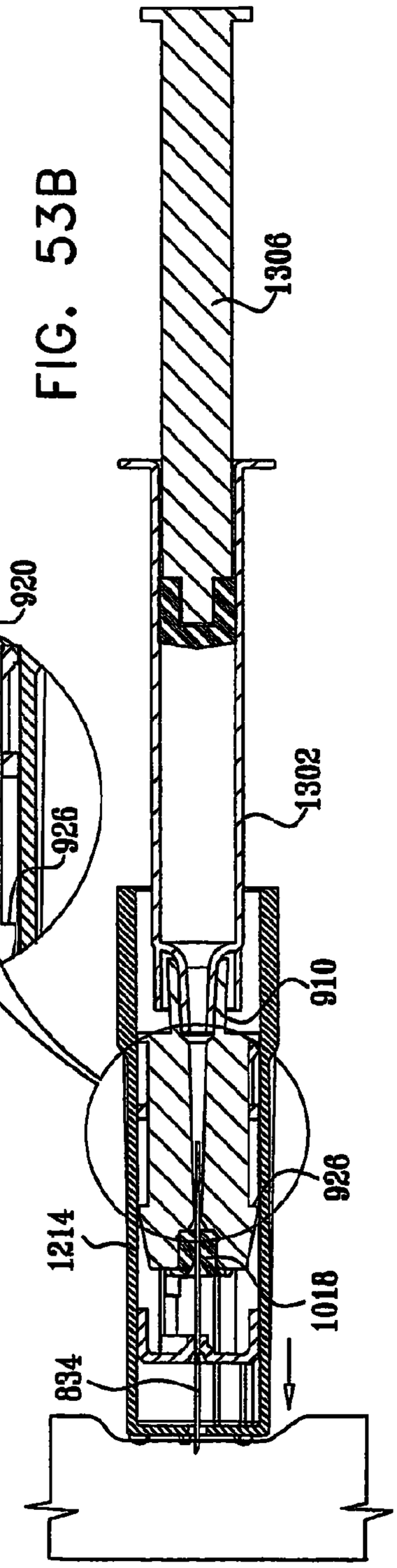


FIG. 53B



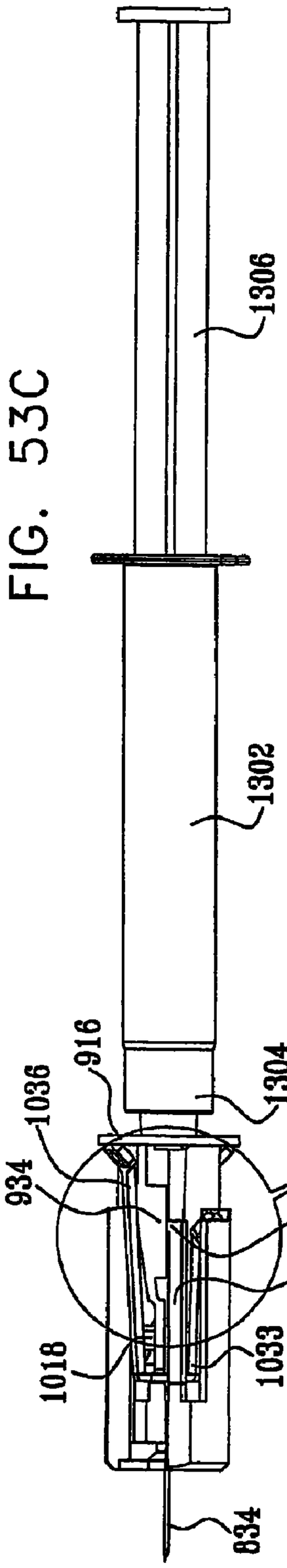
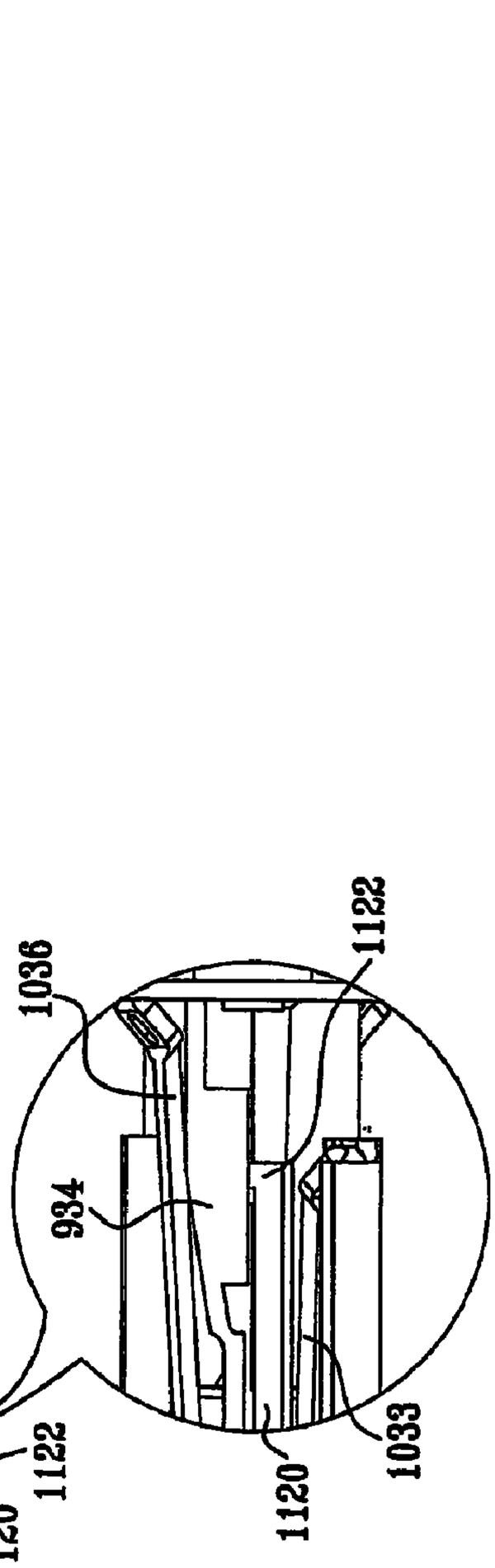


FIG. 53C



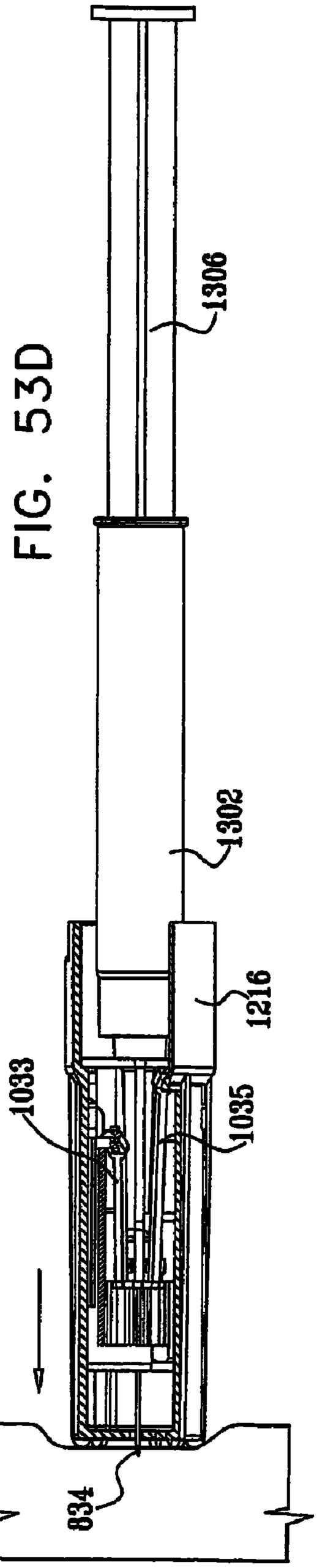
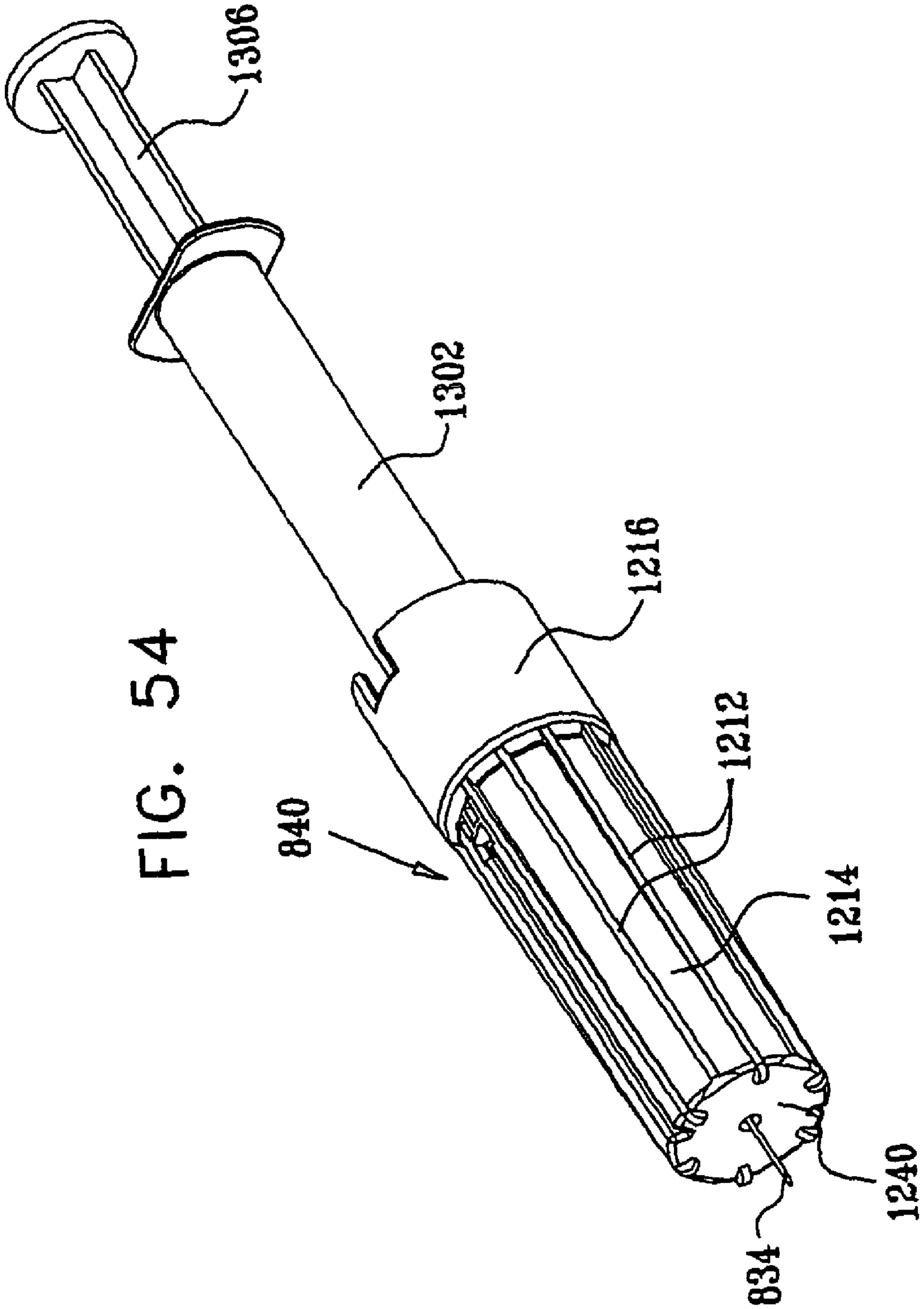


FIG. 53D

FIG. 54



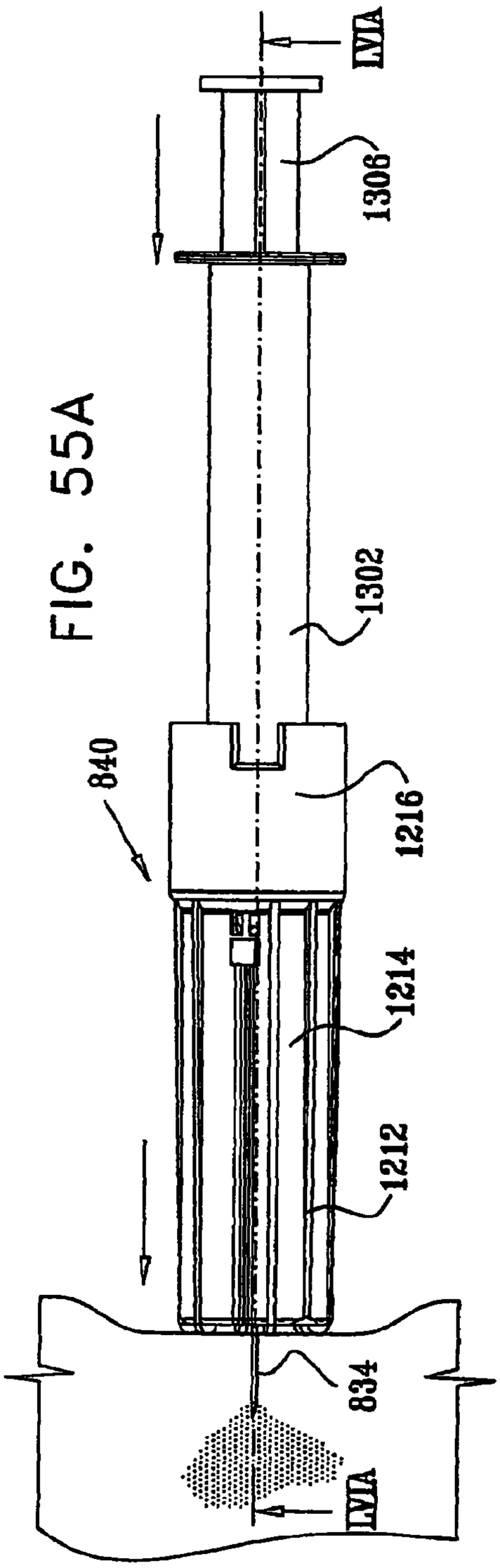


FIG. 55A

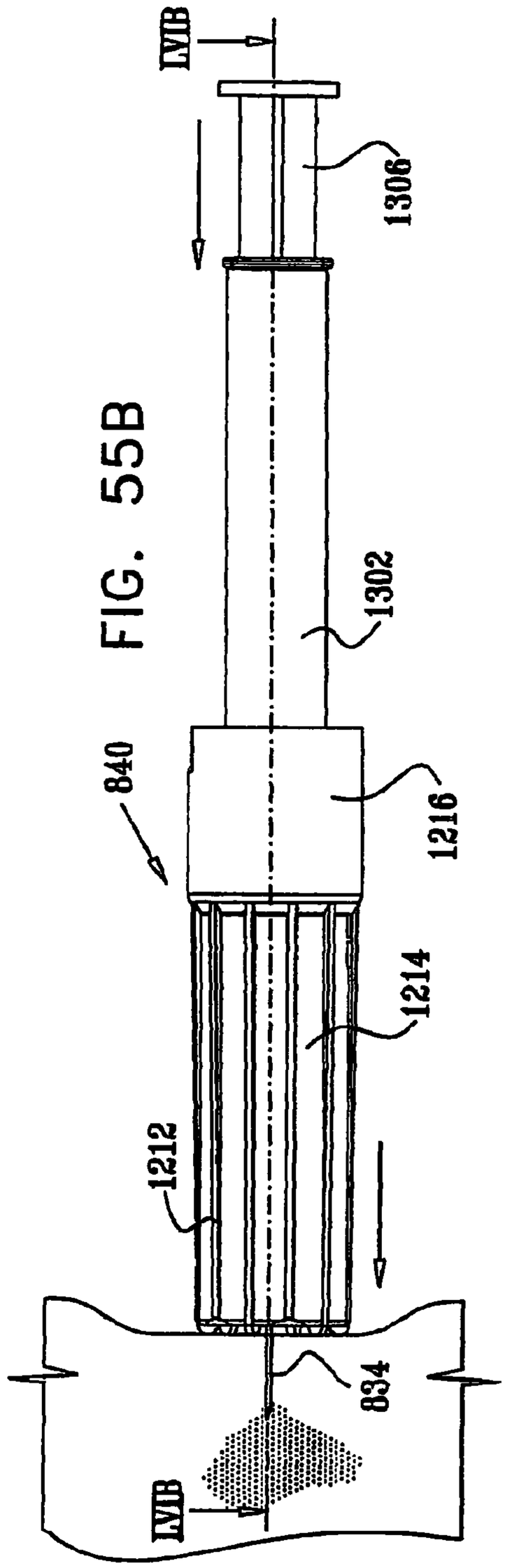


FIG. 55B

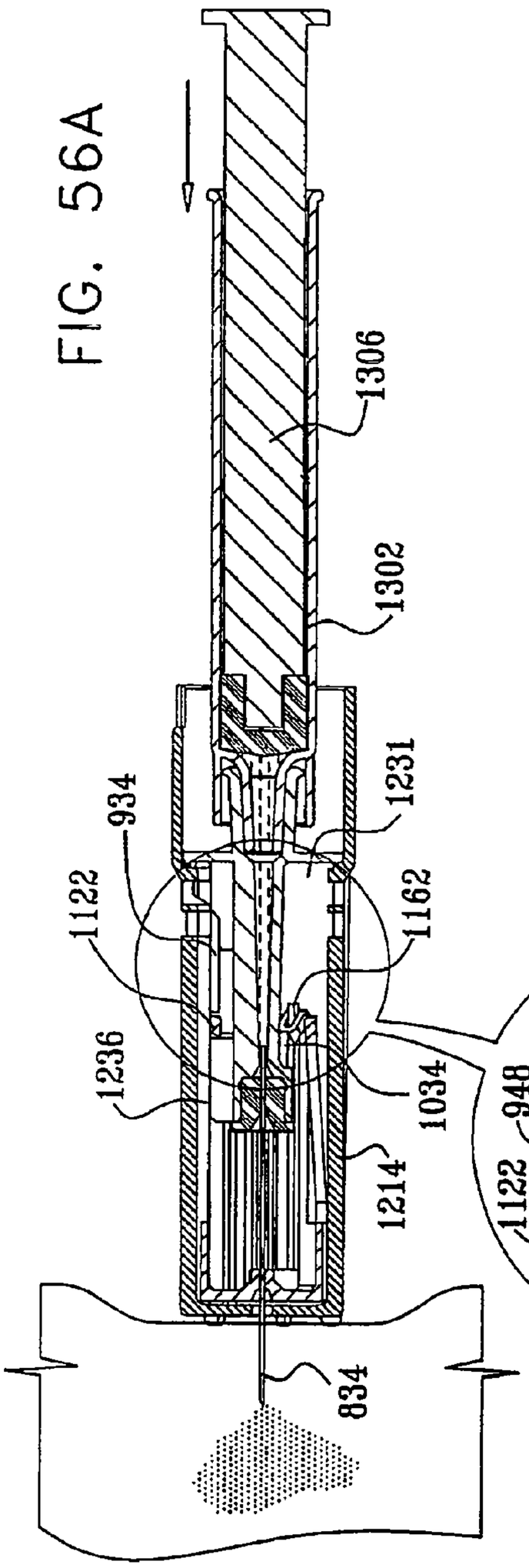
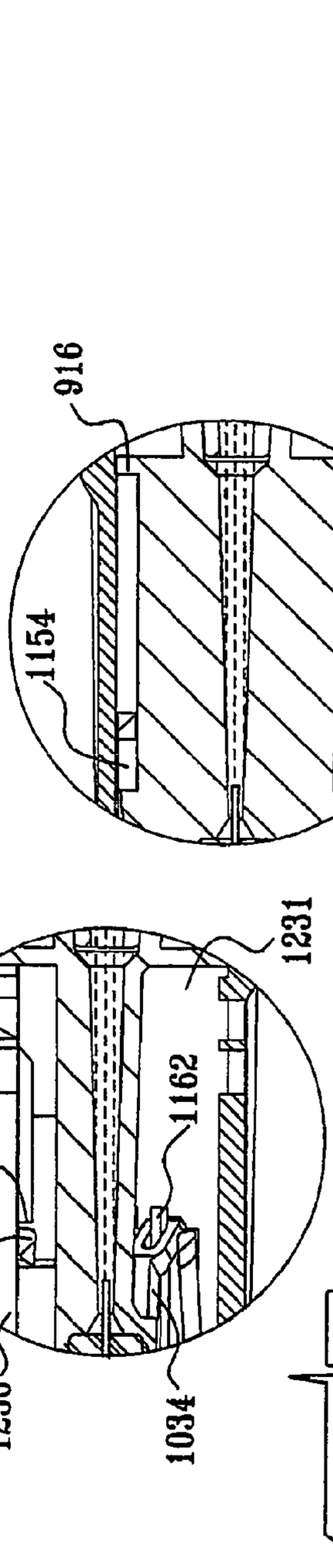


FIG. 56A



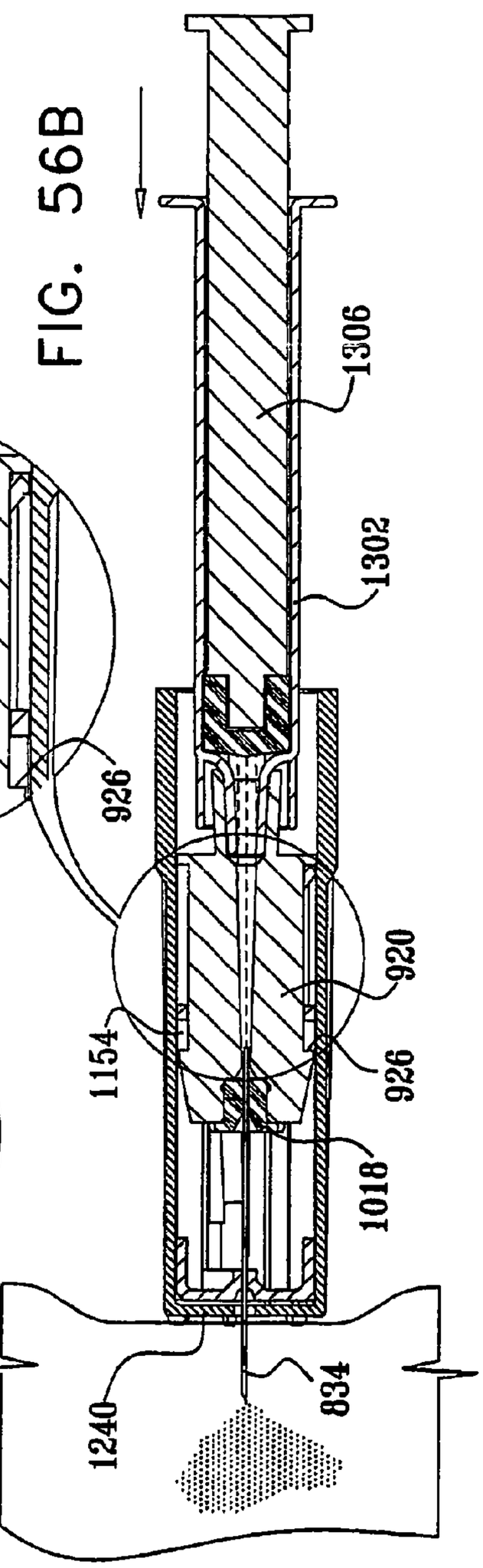


FIG. 56B

FIG. 56C

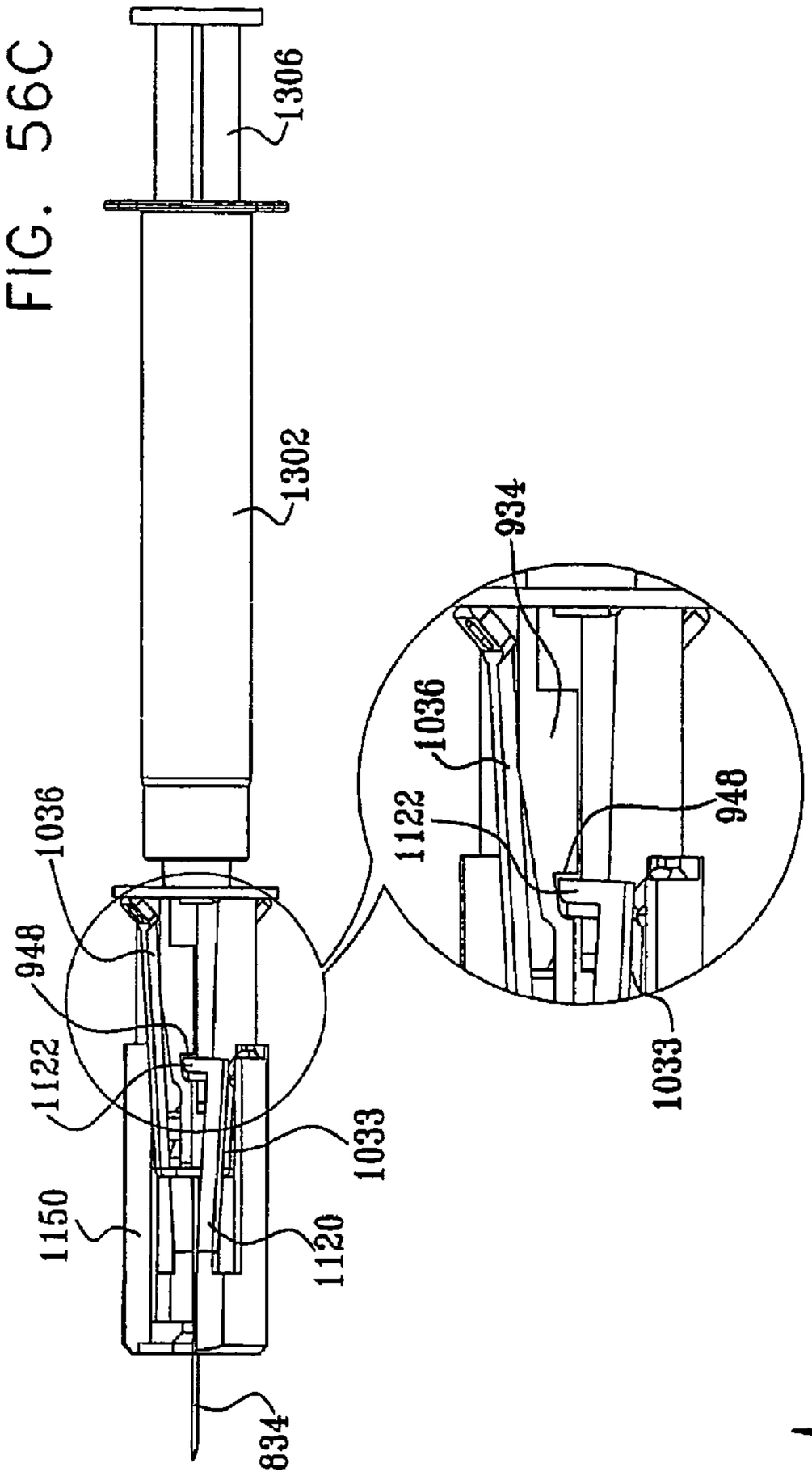
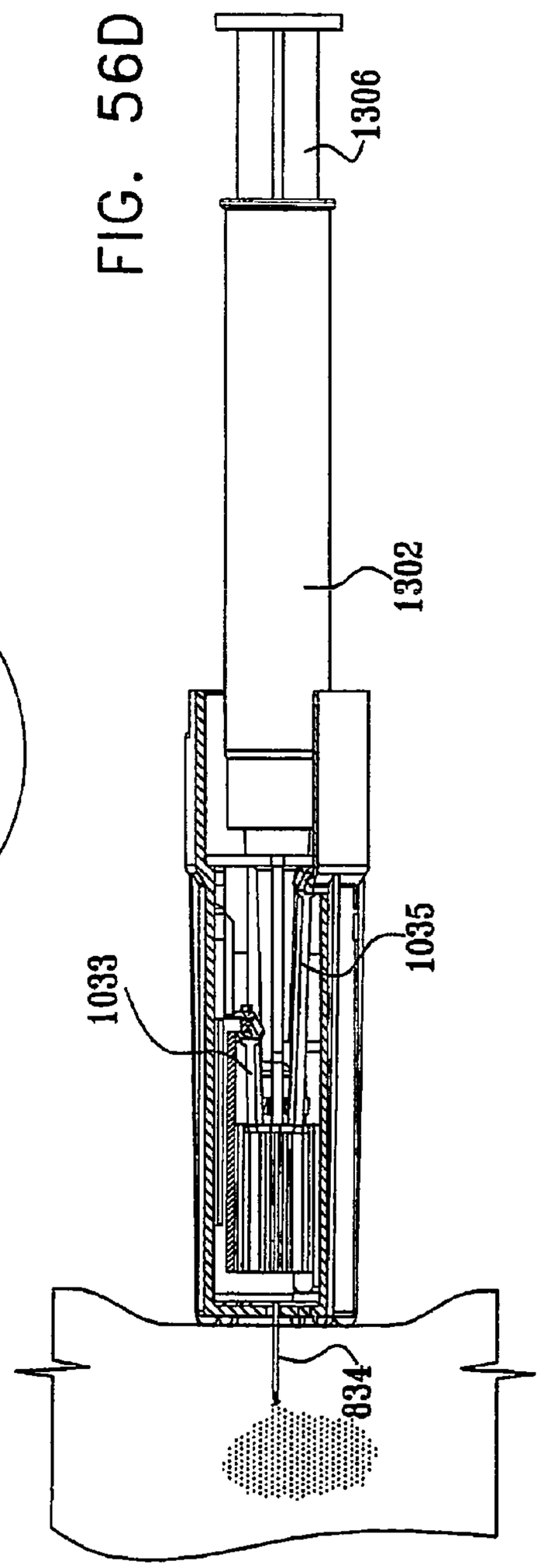


FIG. 56D



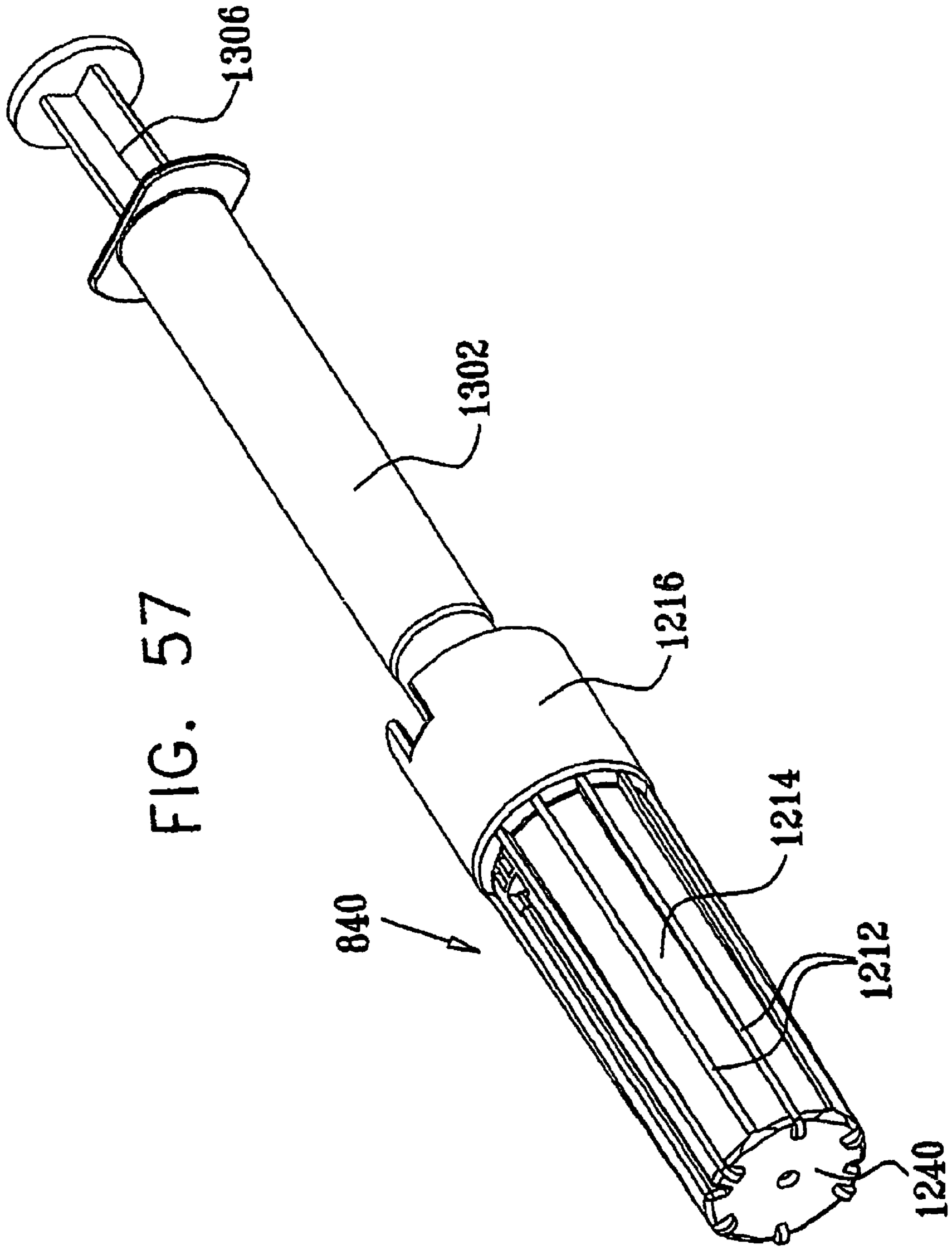


FIG. 57

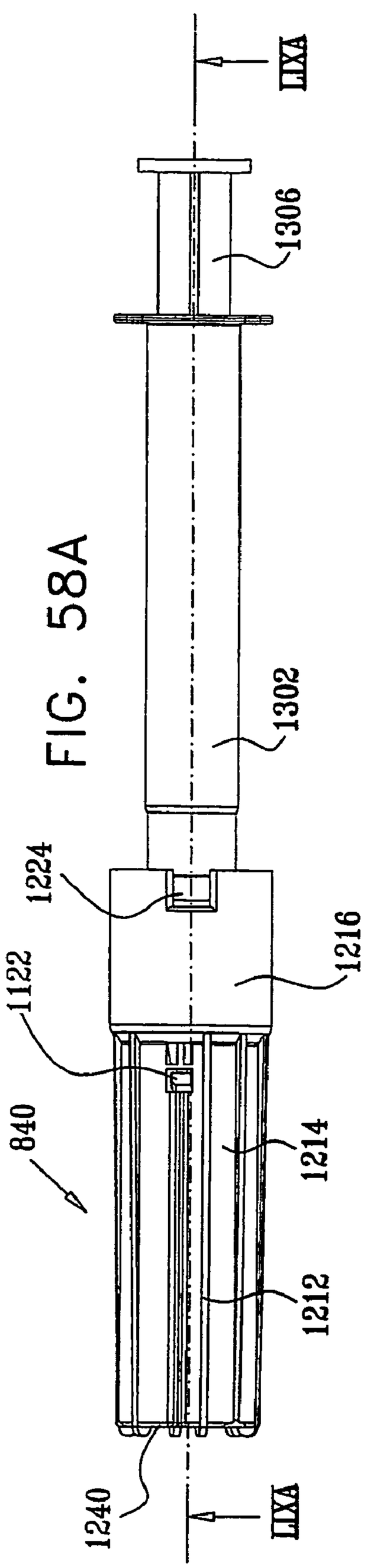


FIG. 58A

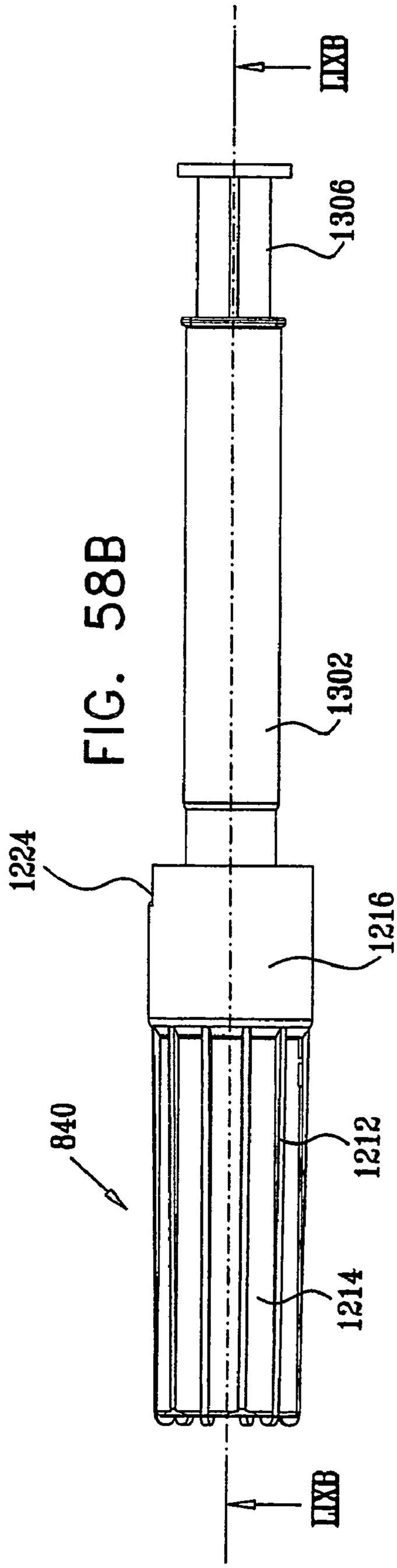


FIG. 58B

FIG. 59A

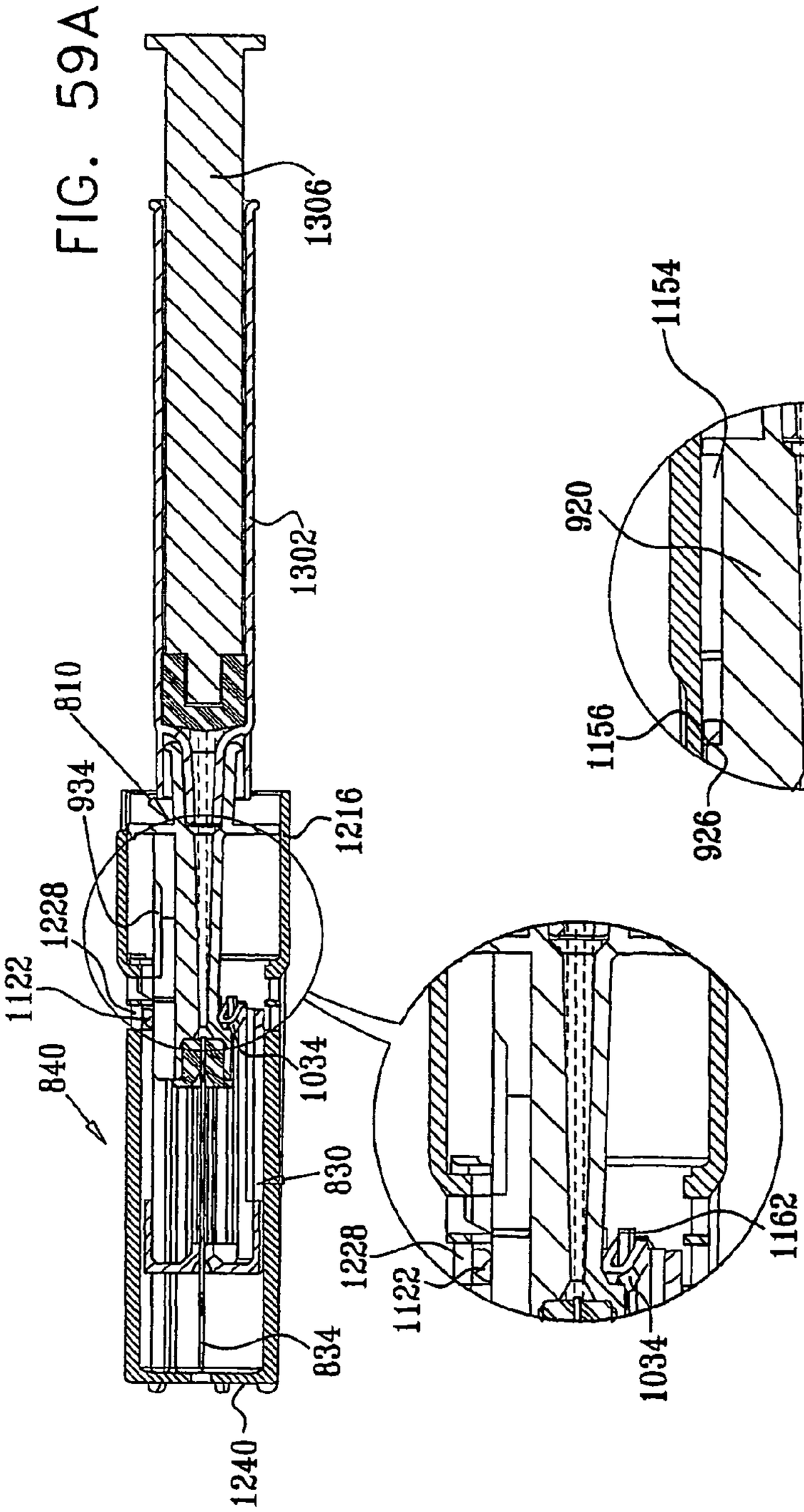


FIG. 59B

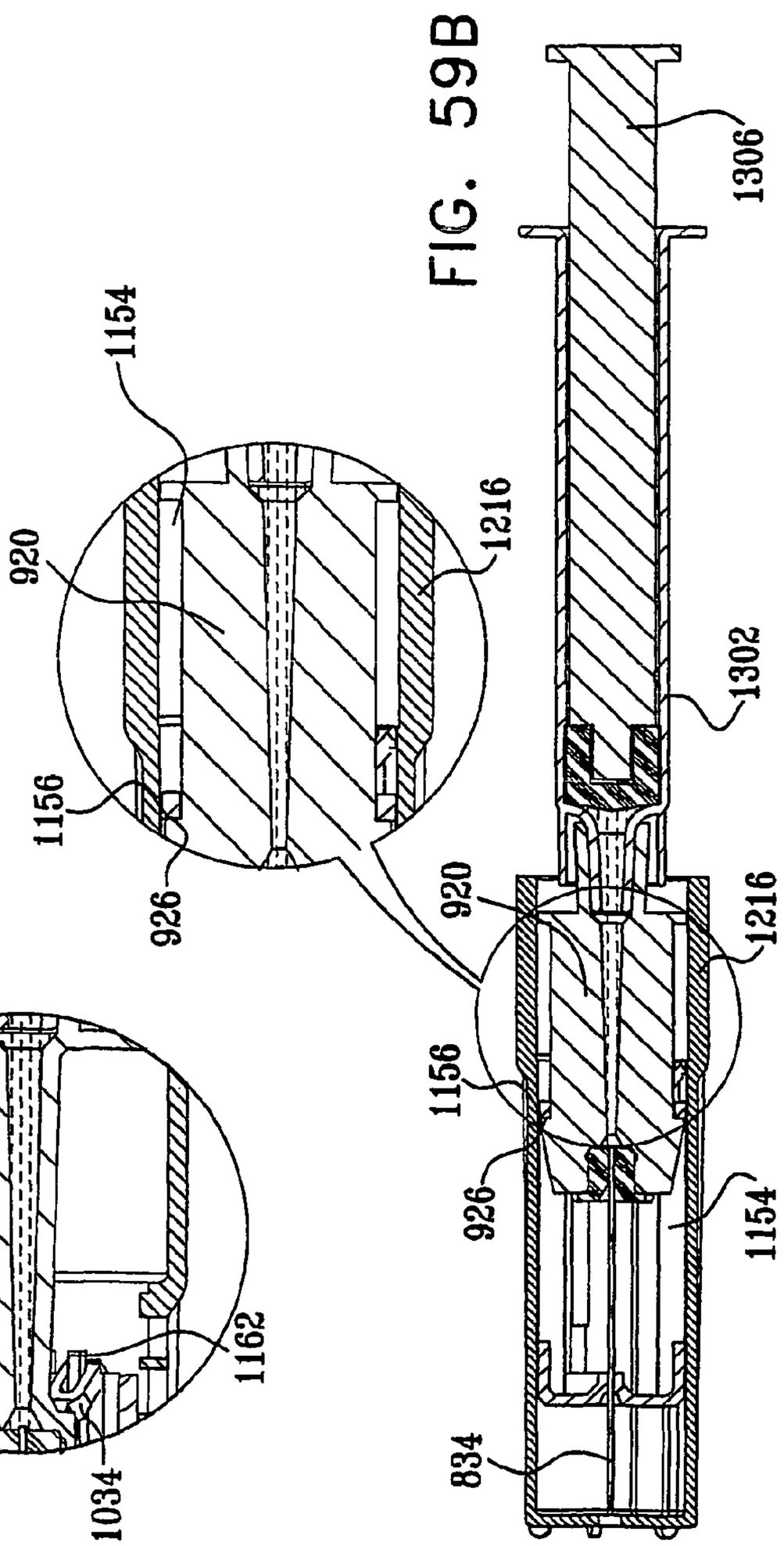


FIG. 59C

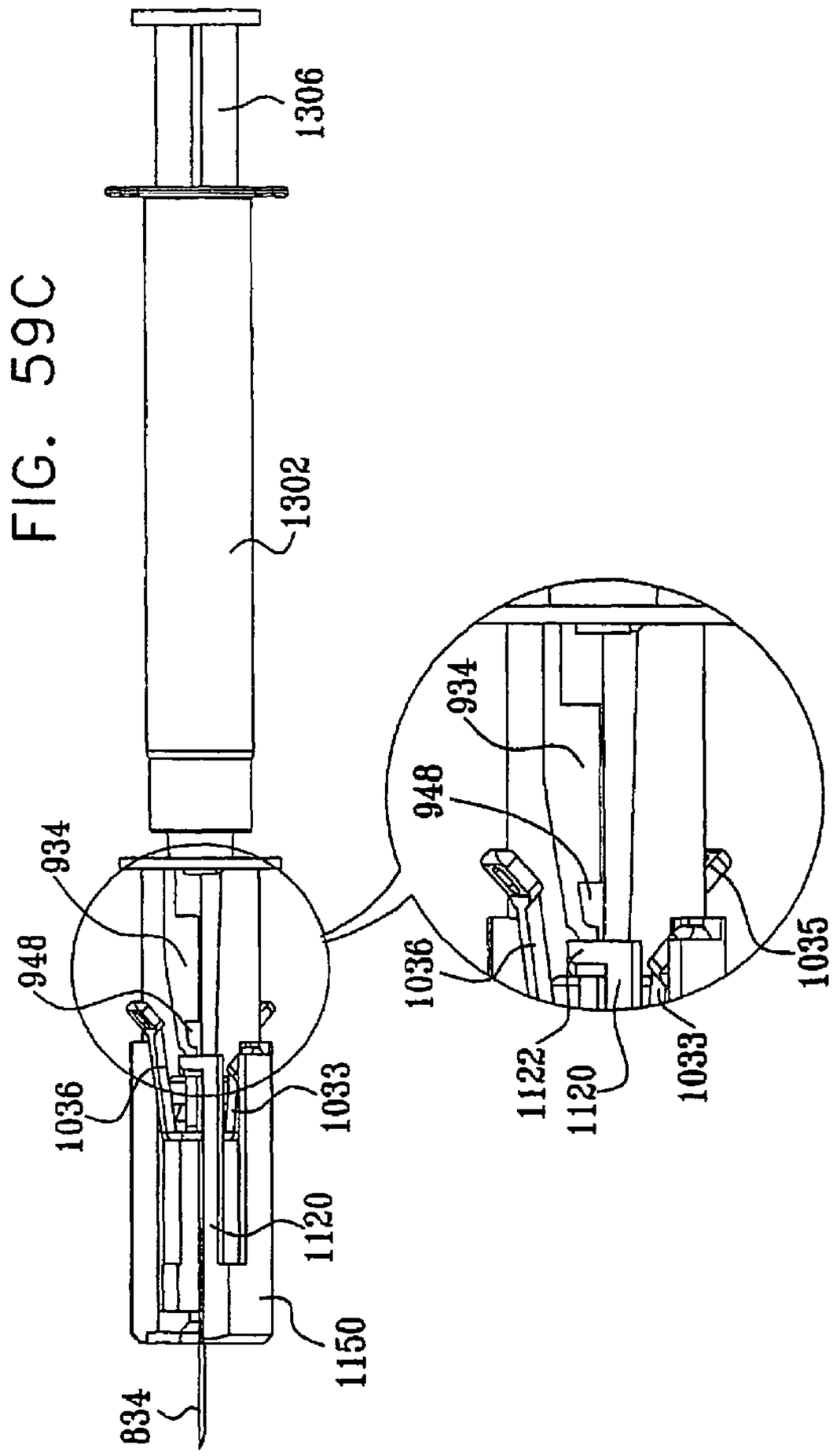
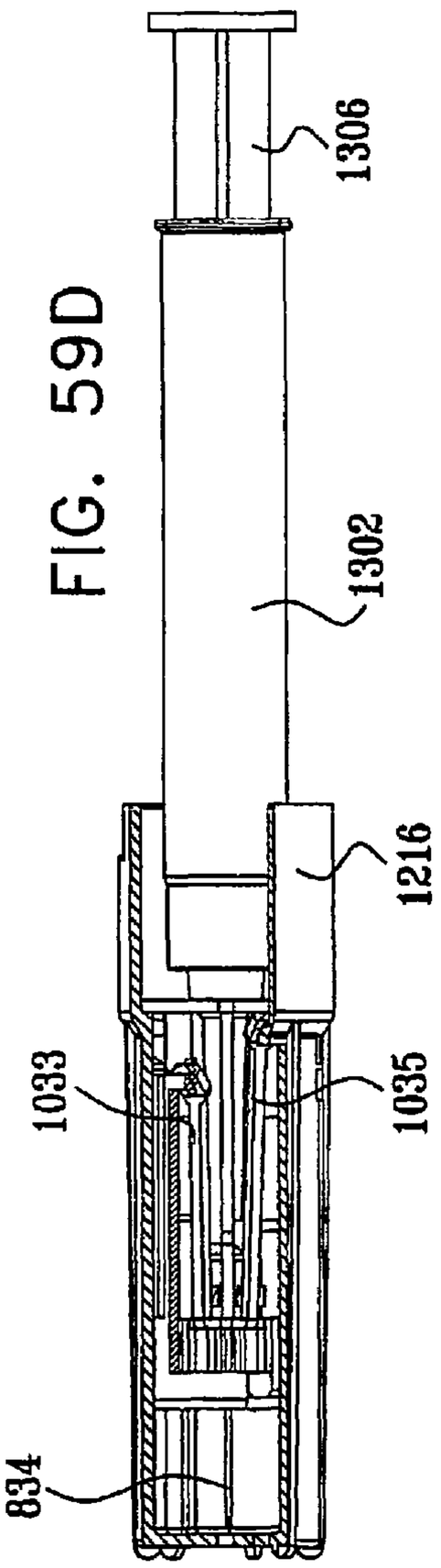


FIG. 59D



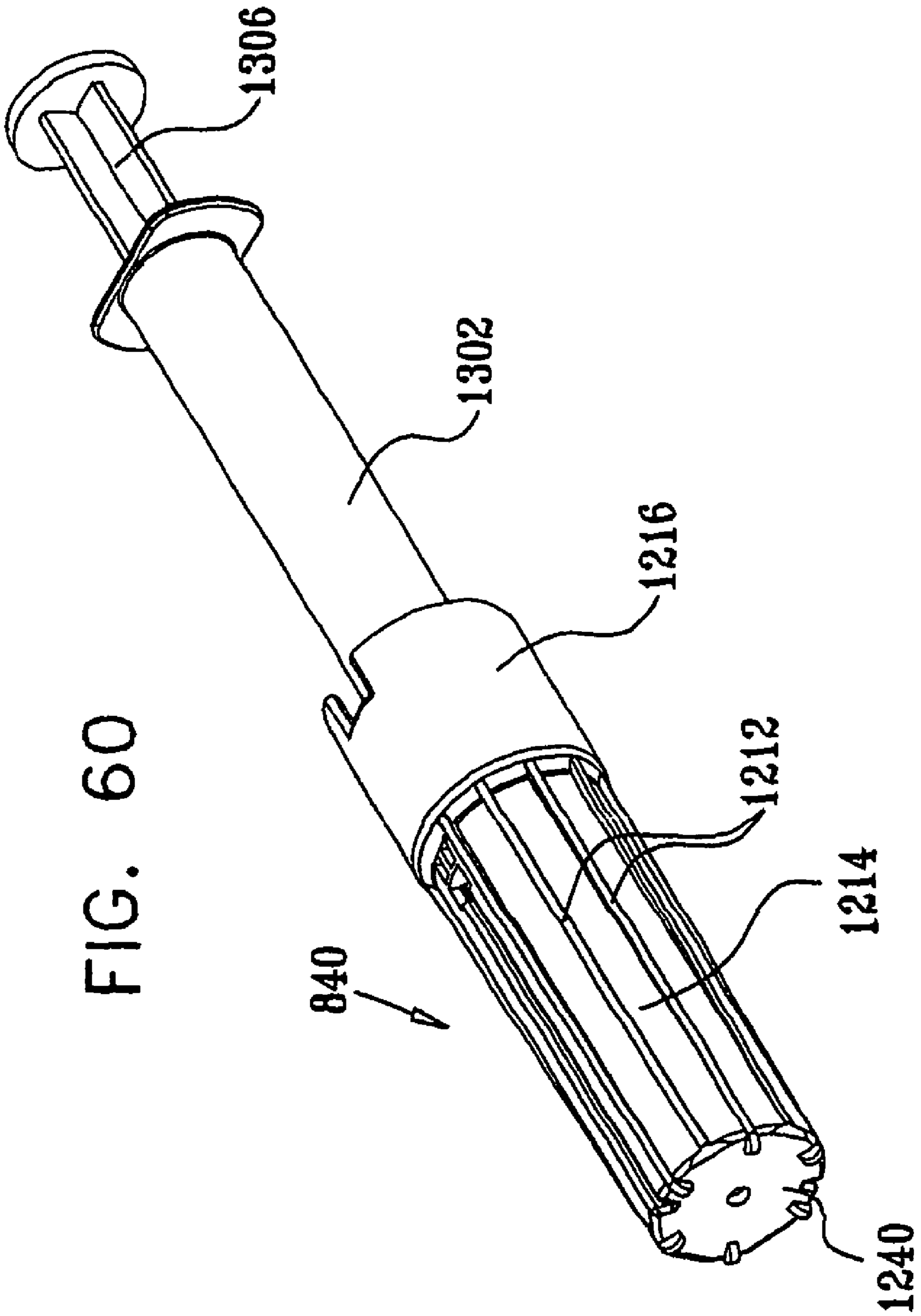


FIG. 60

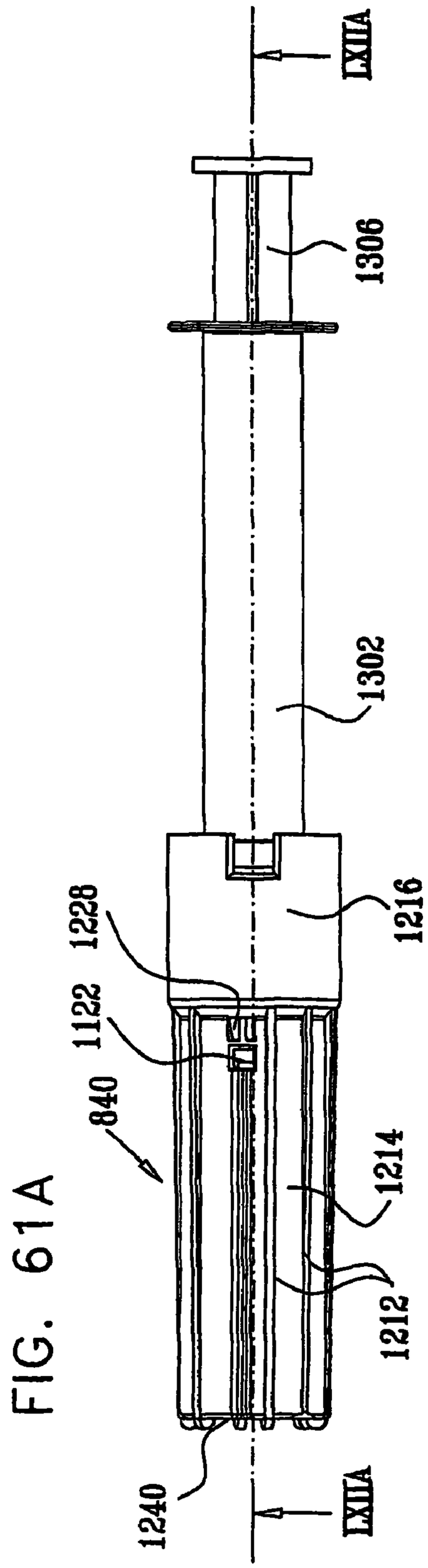


FIG. 61A

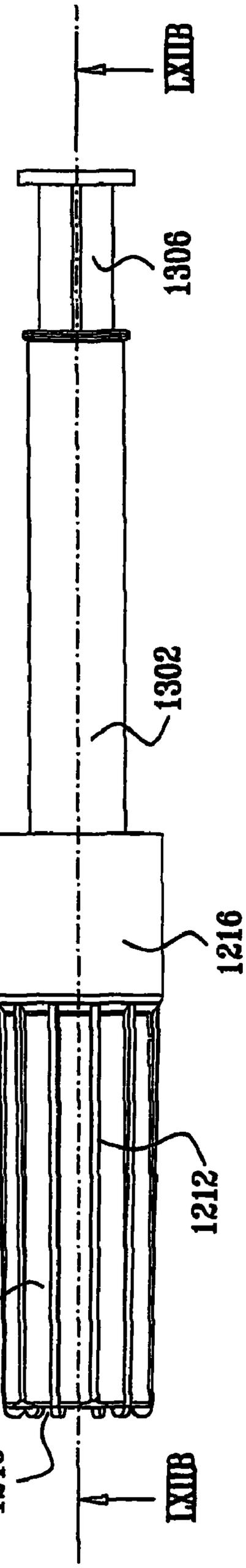


FIG. 61B

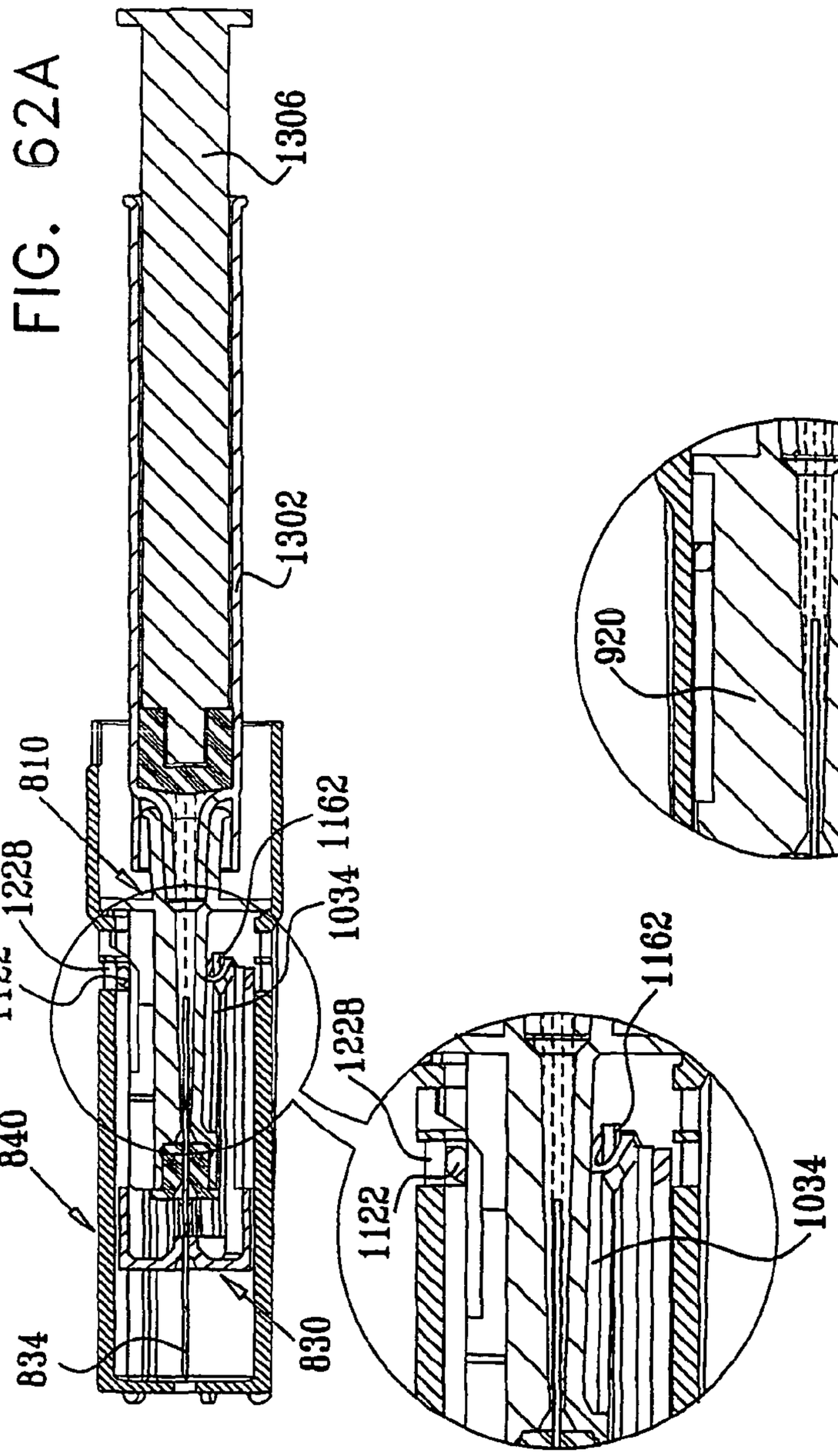


FIG. 62A

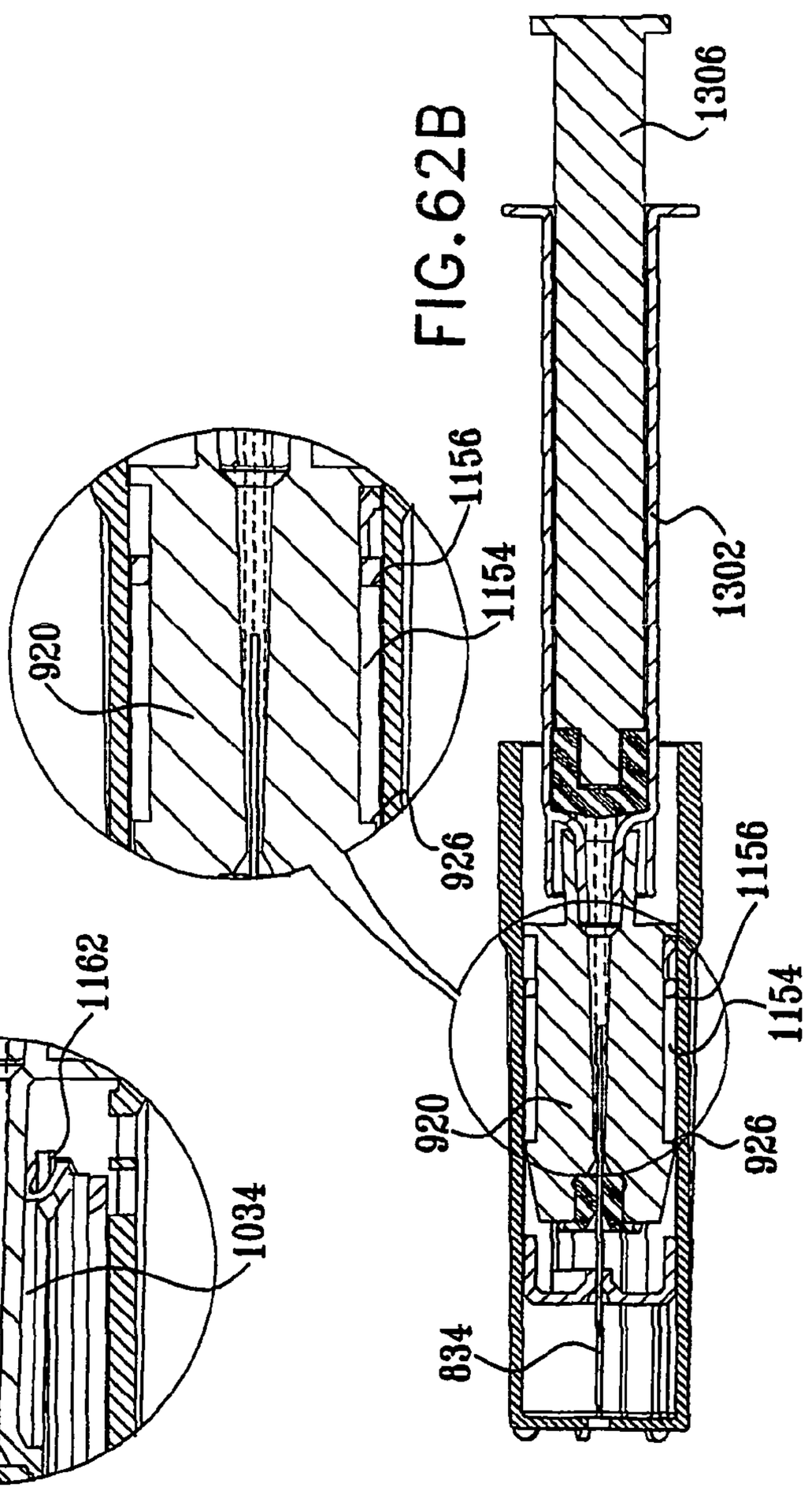


FIG. 62B

FIG. 62C

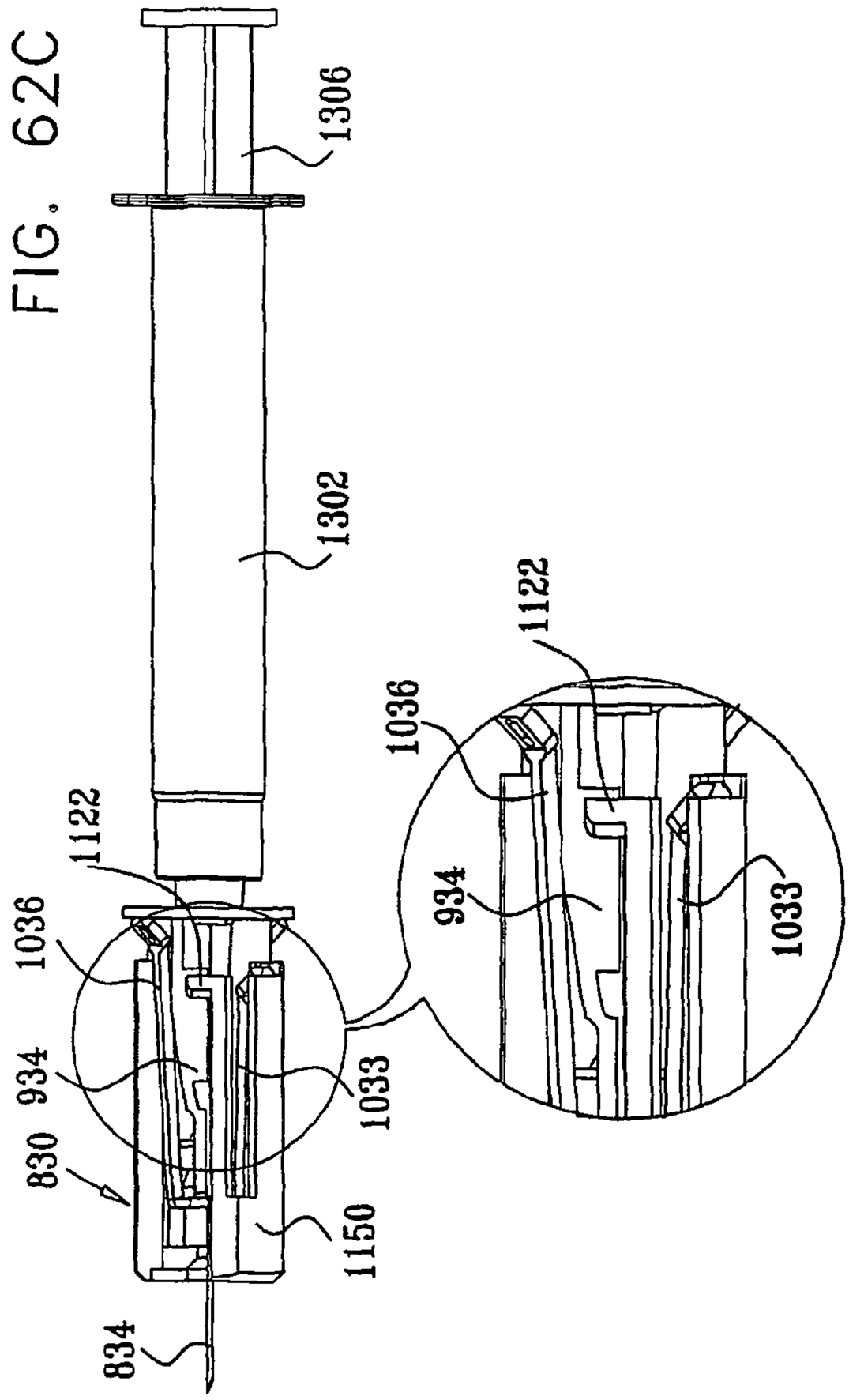


FIG. 62D

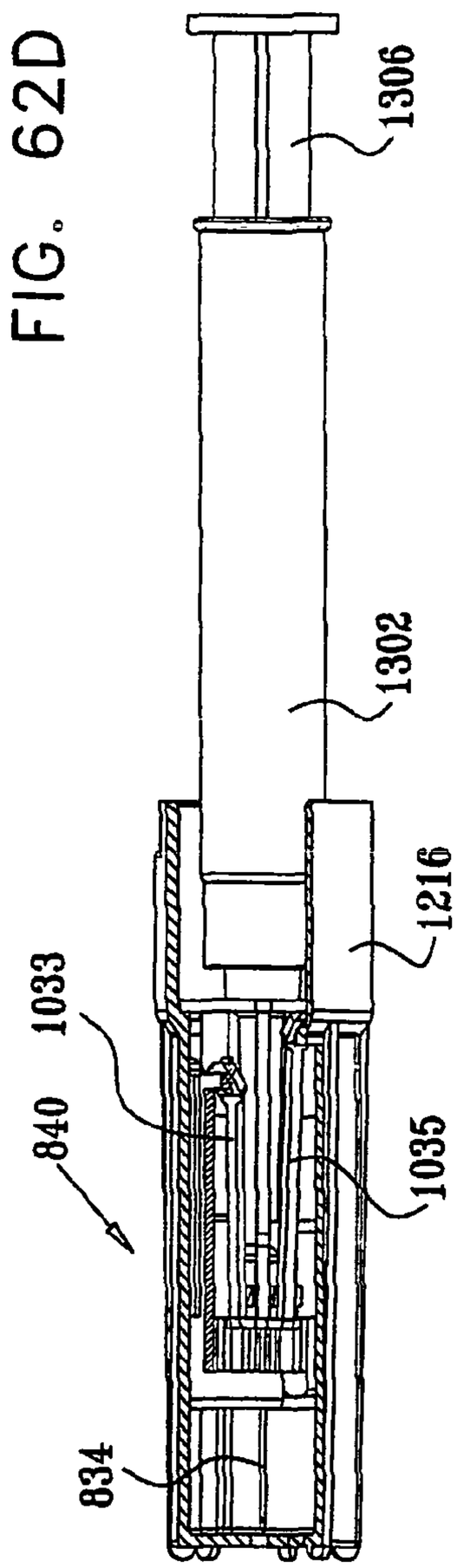
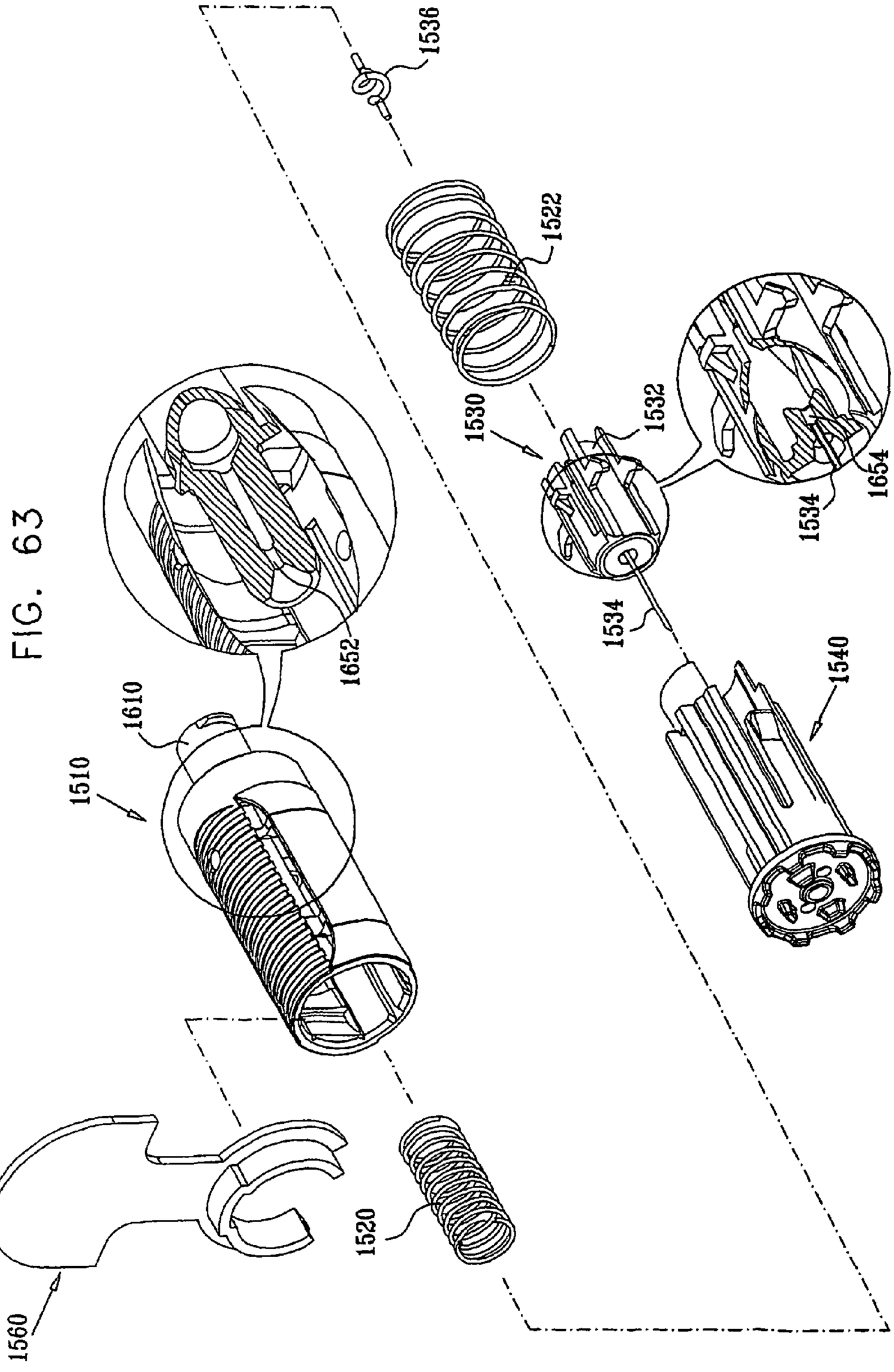


FIG. 63


1536
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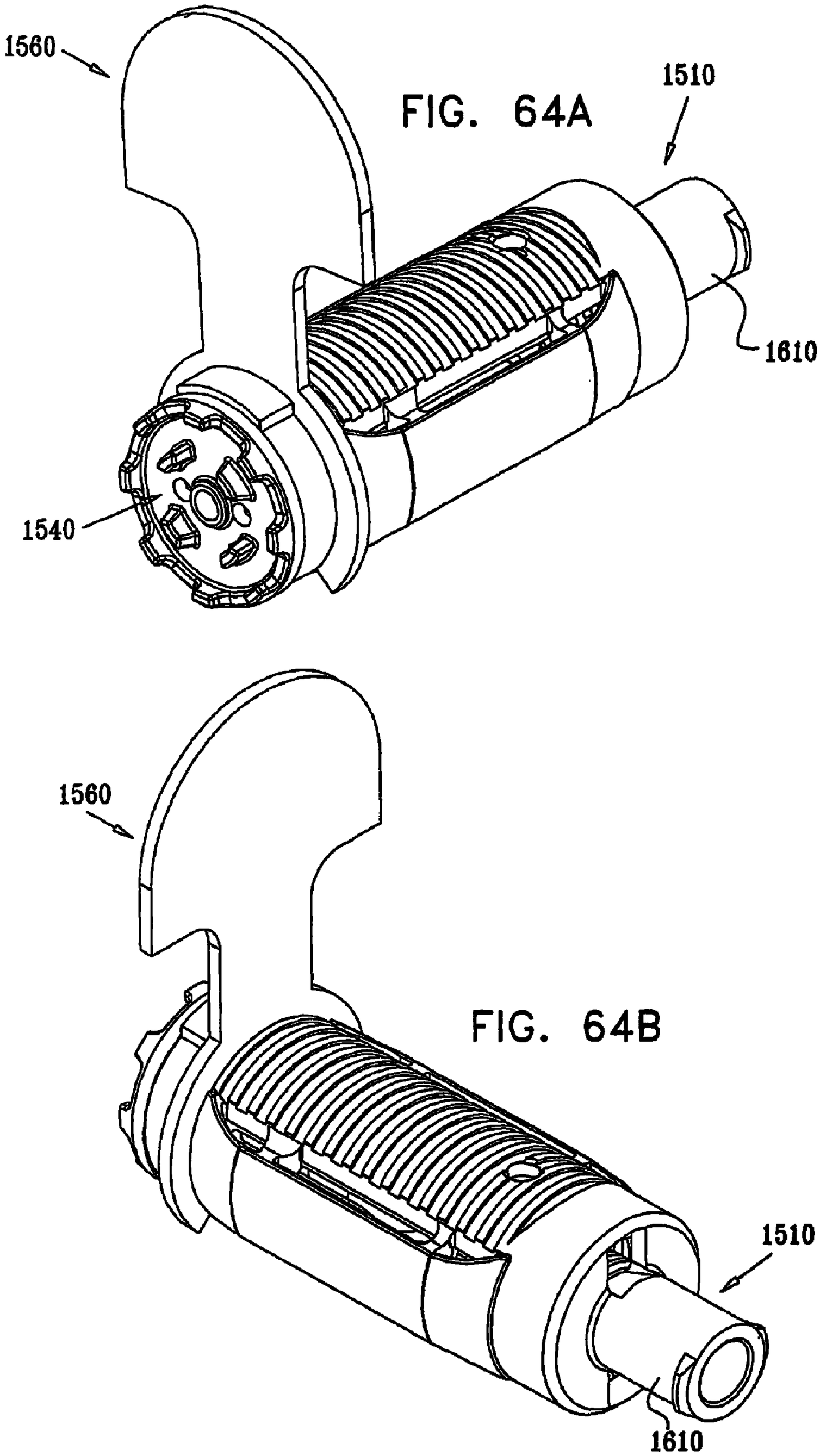


FIG. 64A

FIG. 64B

FIG. 65A

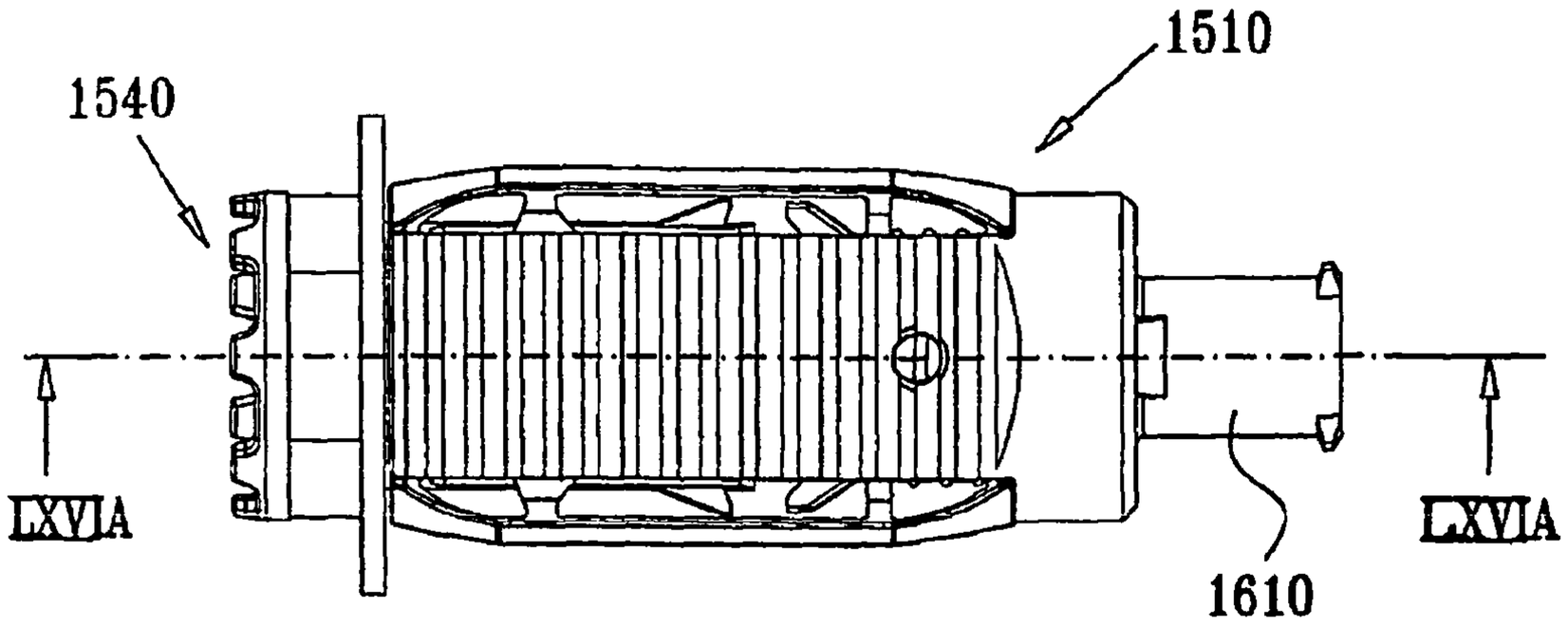
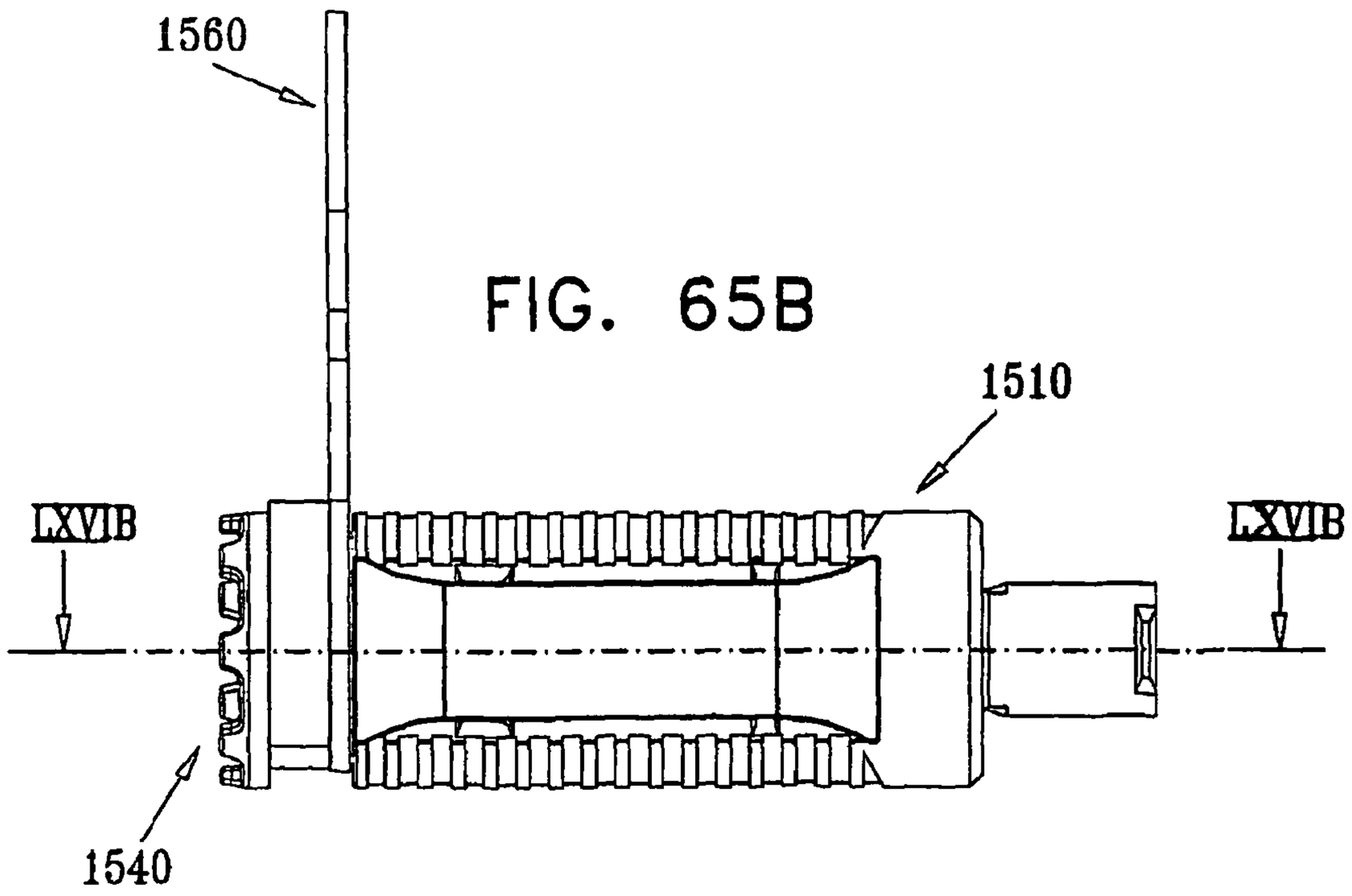


FIG. 65B



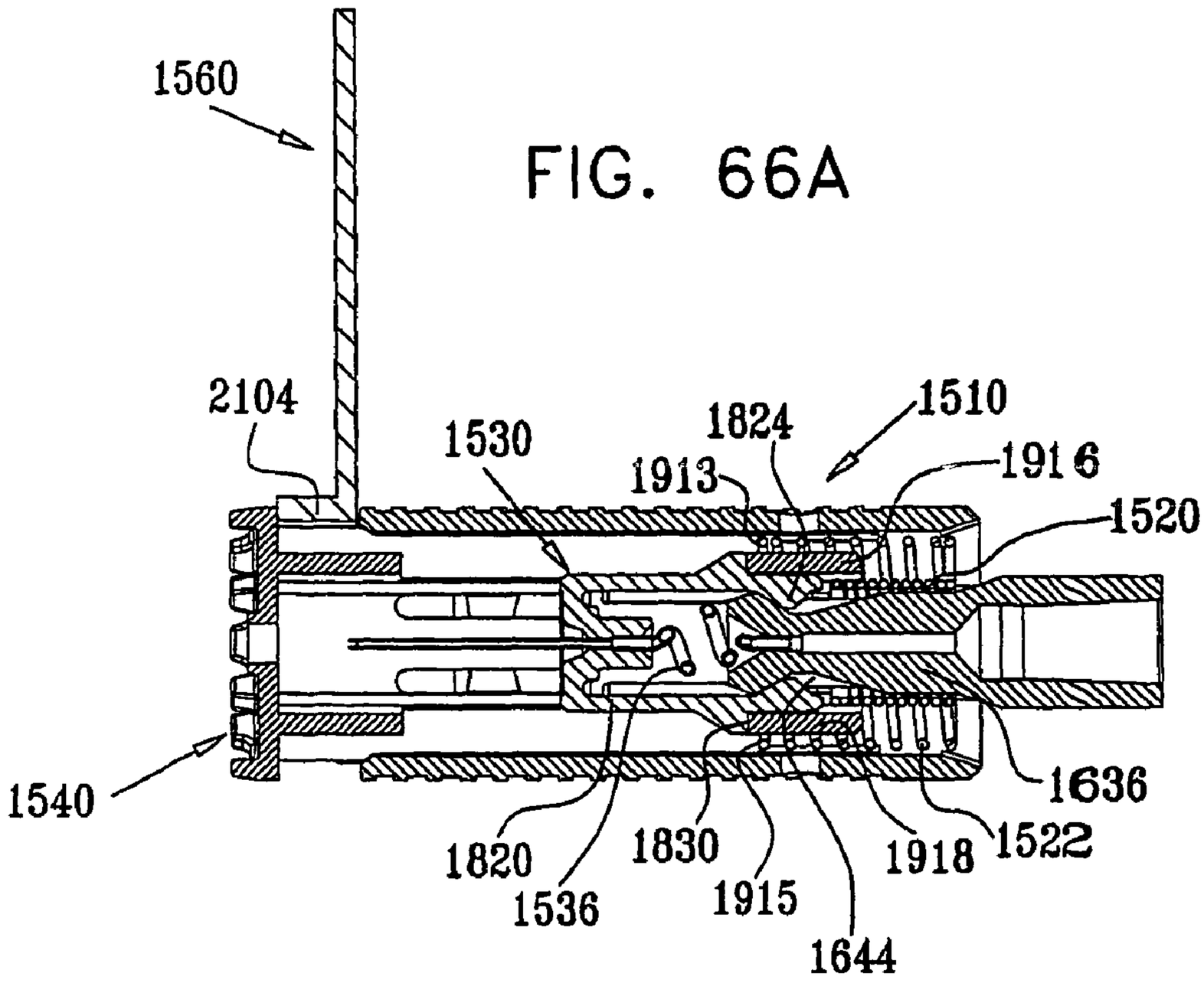


FIG. 66A

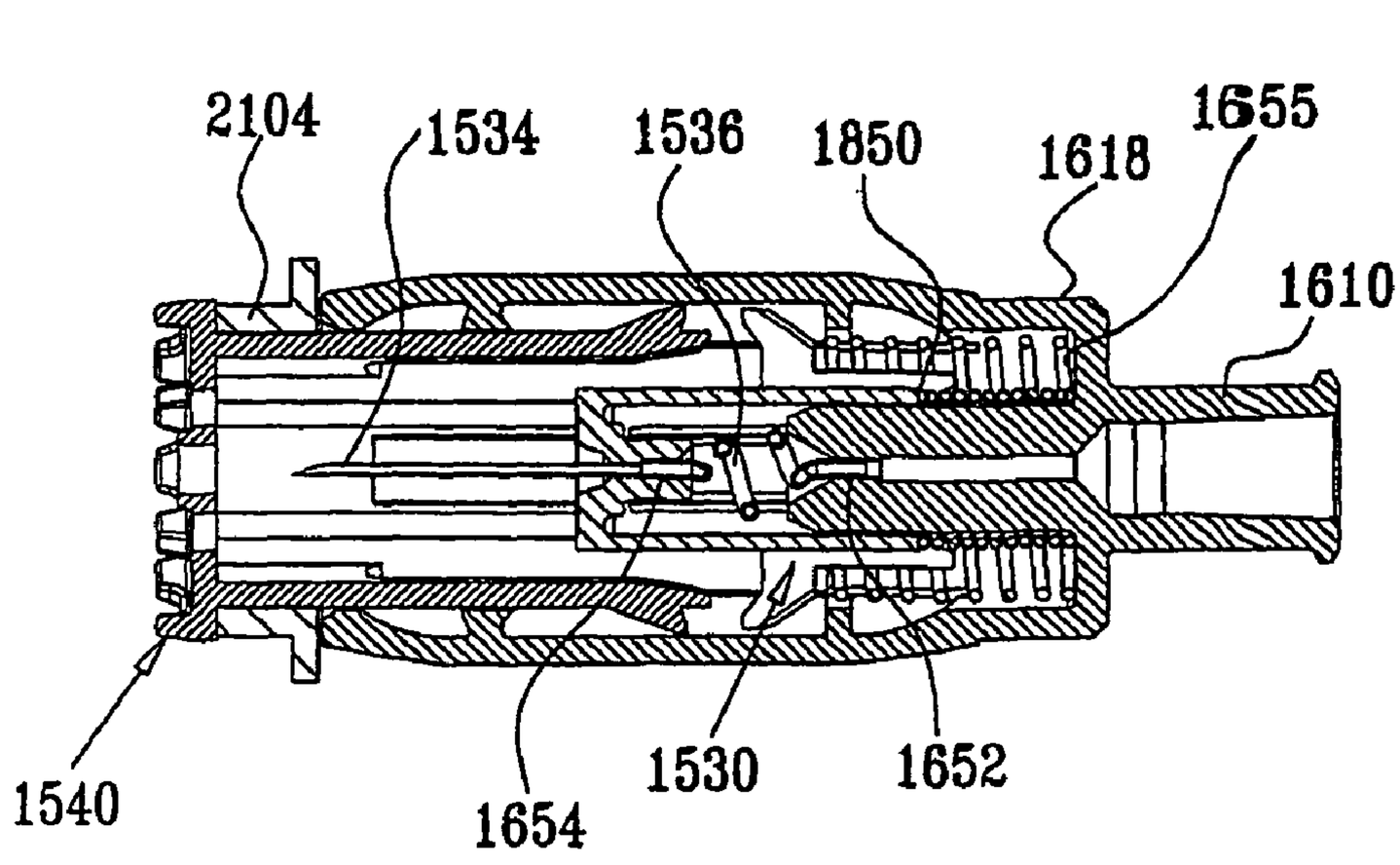


FIG. 66B

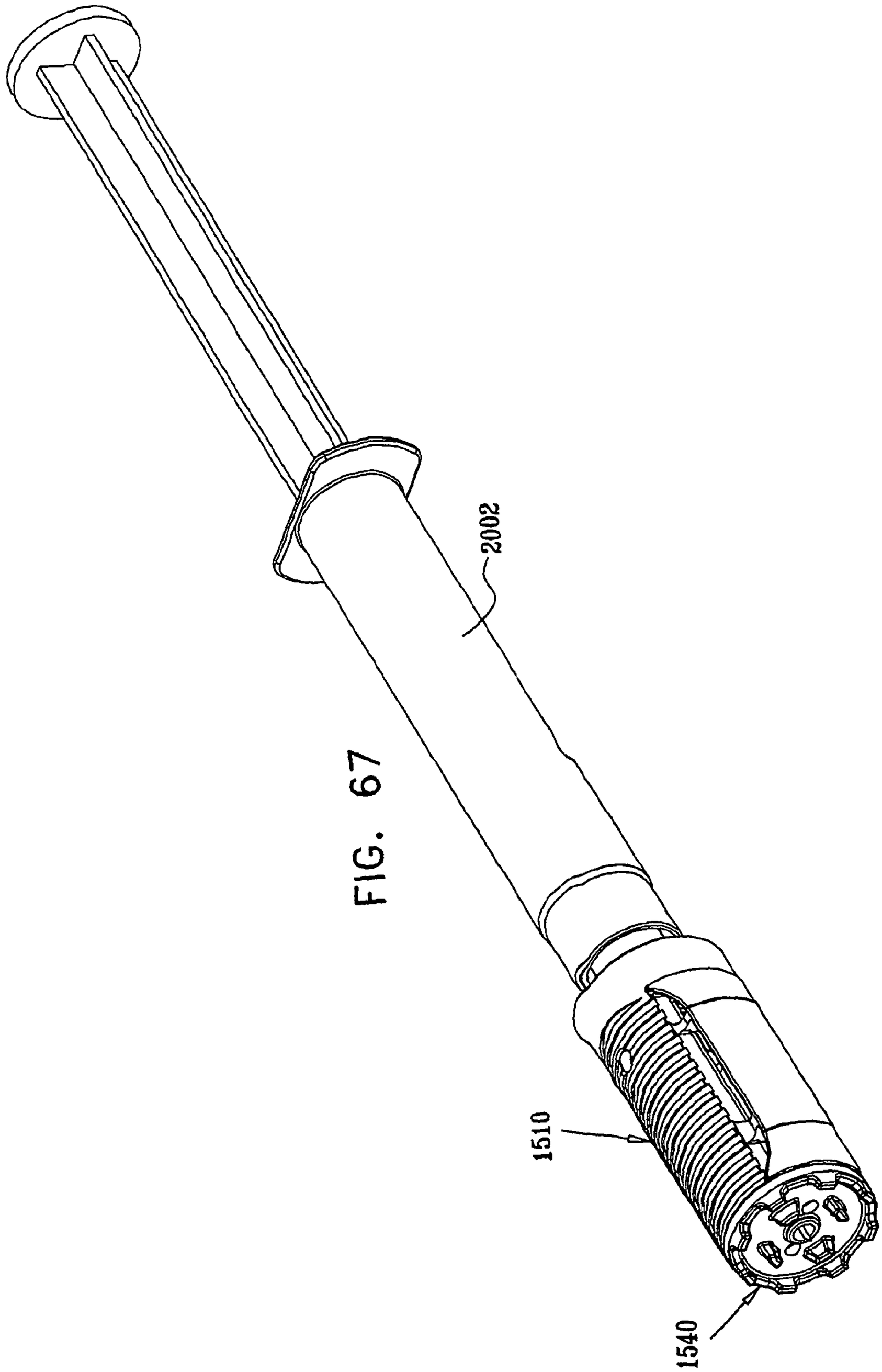


FIG. 67

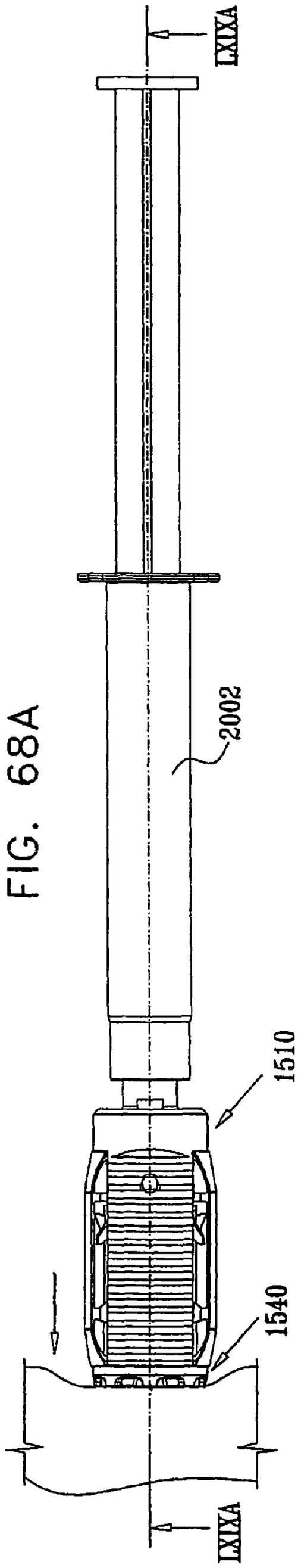


FIG. 68A

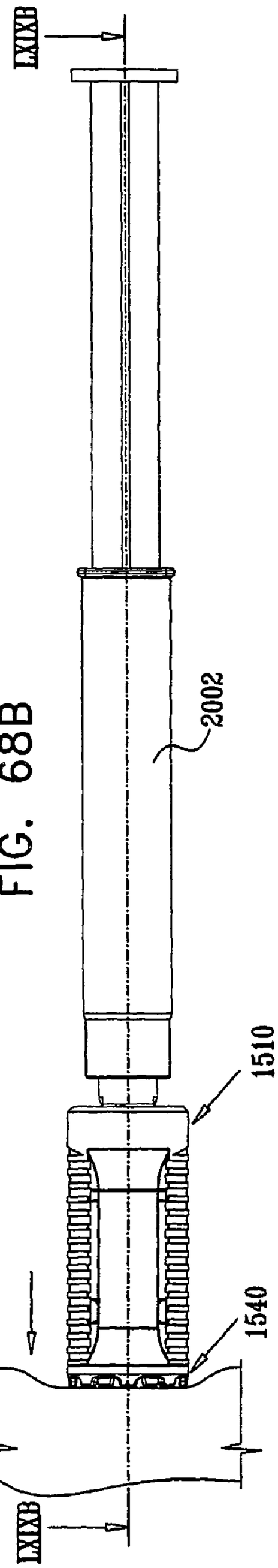


FIG. 68B

FIG. 69A

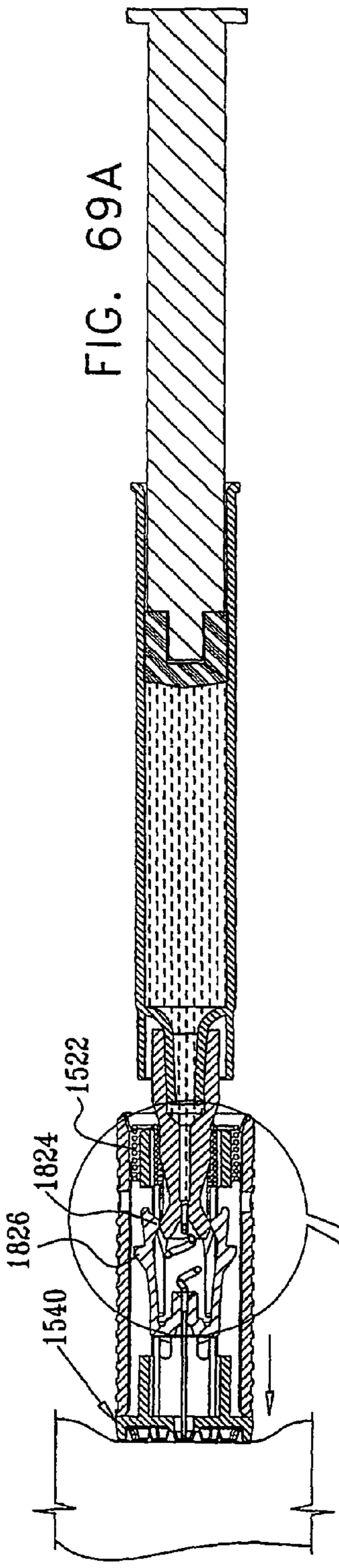
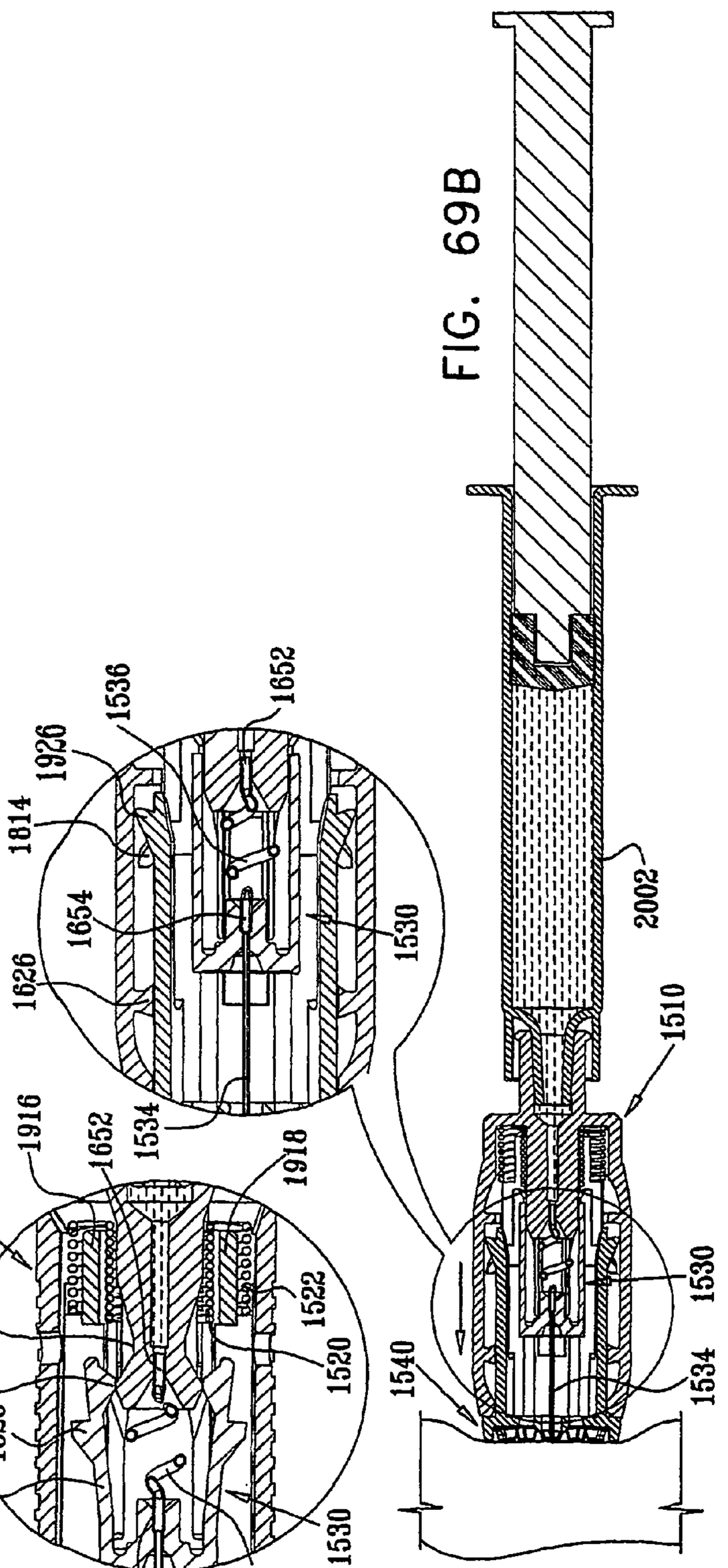


FIG. 69B



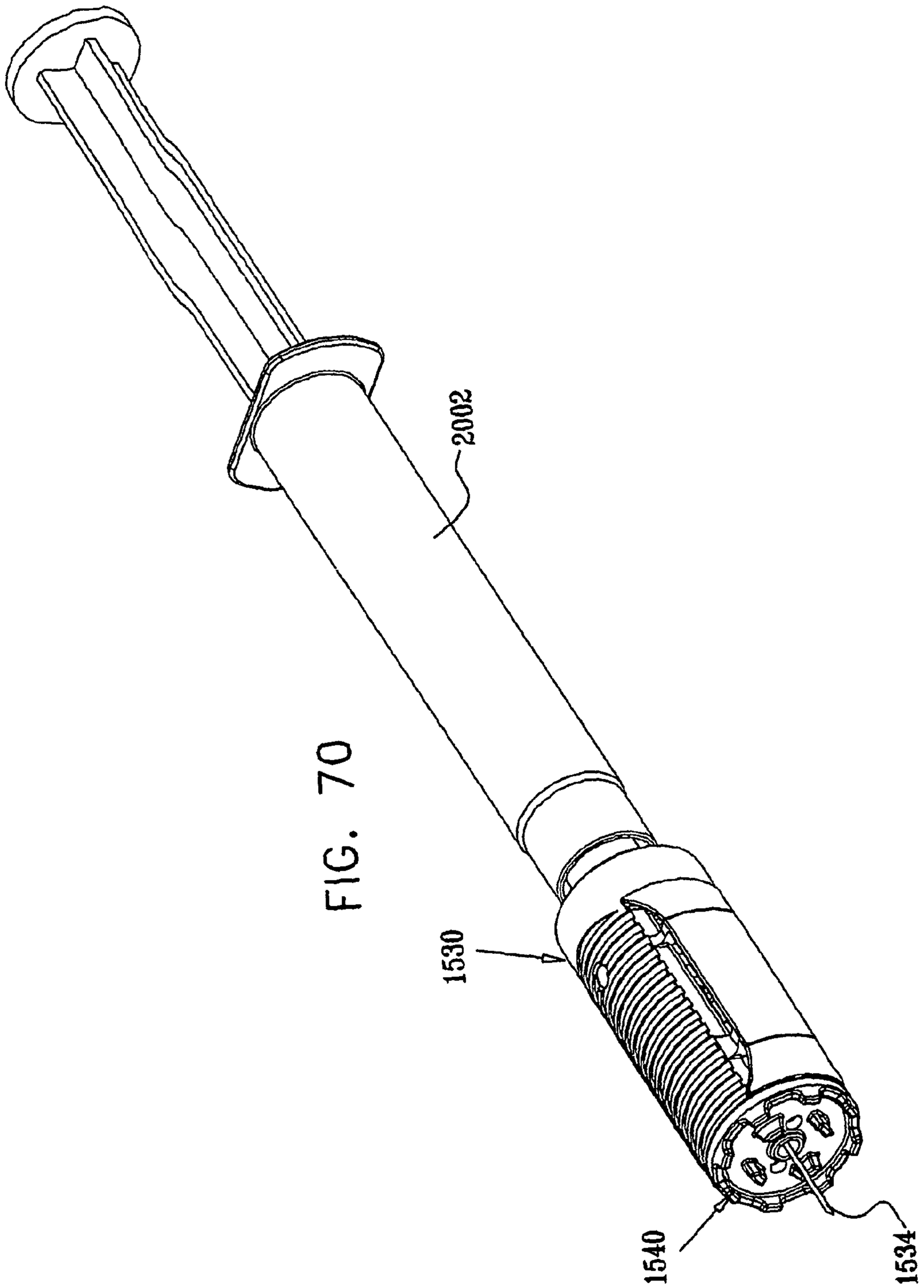


FIG. 70

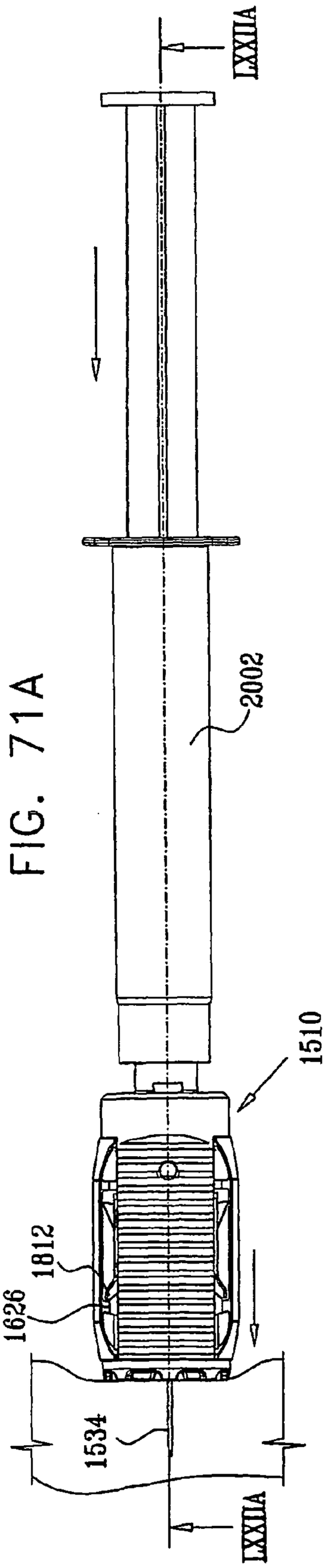


FIG. 71A

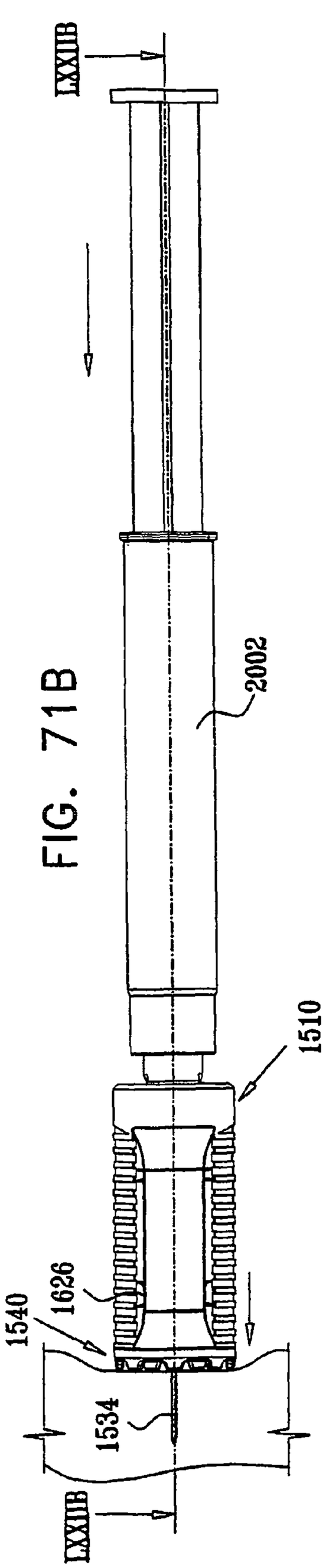


FIG. 71B

FIG. 72A

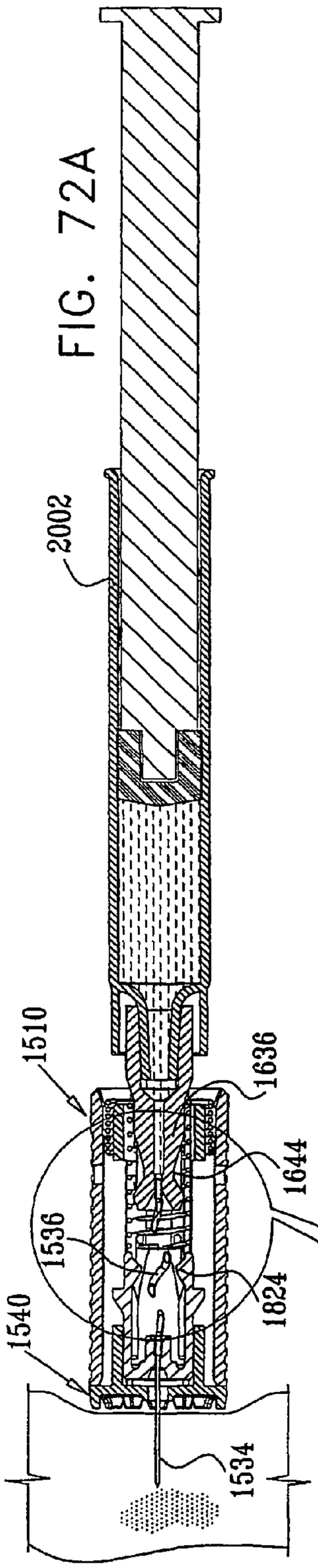
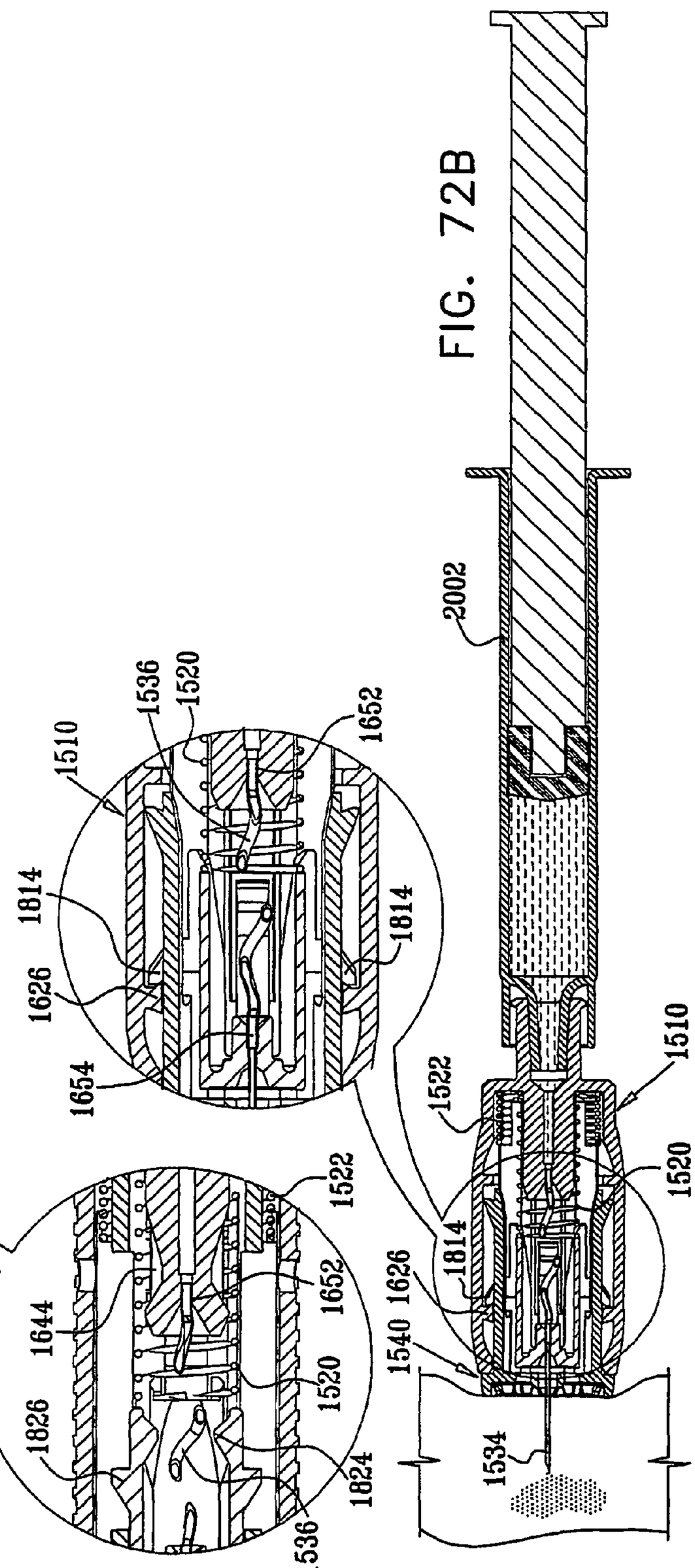


FIG. 72B



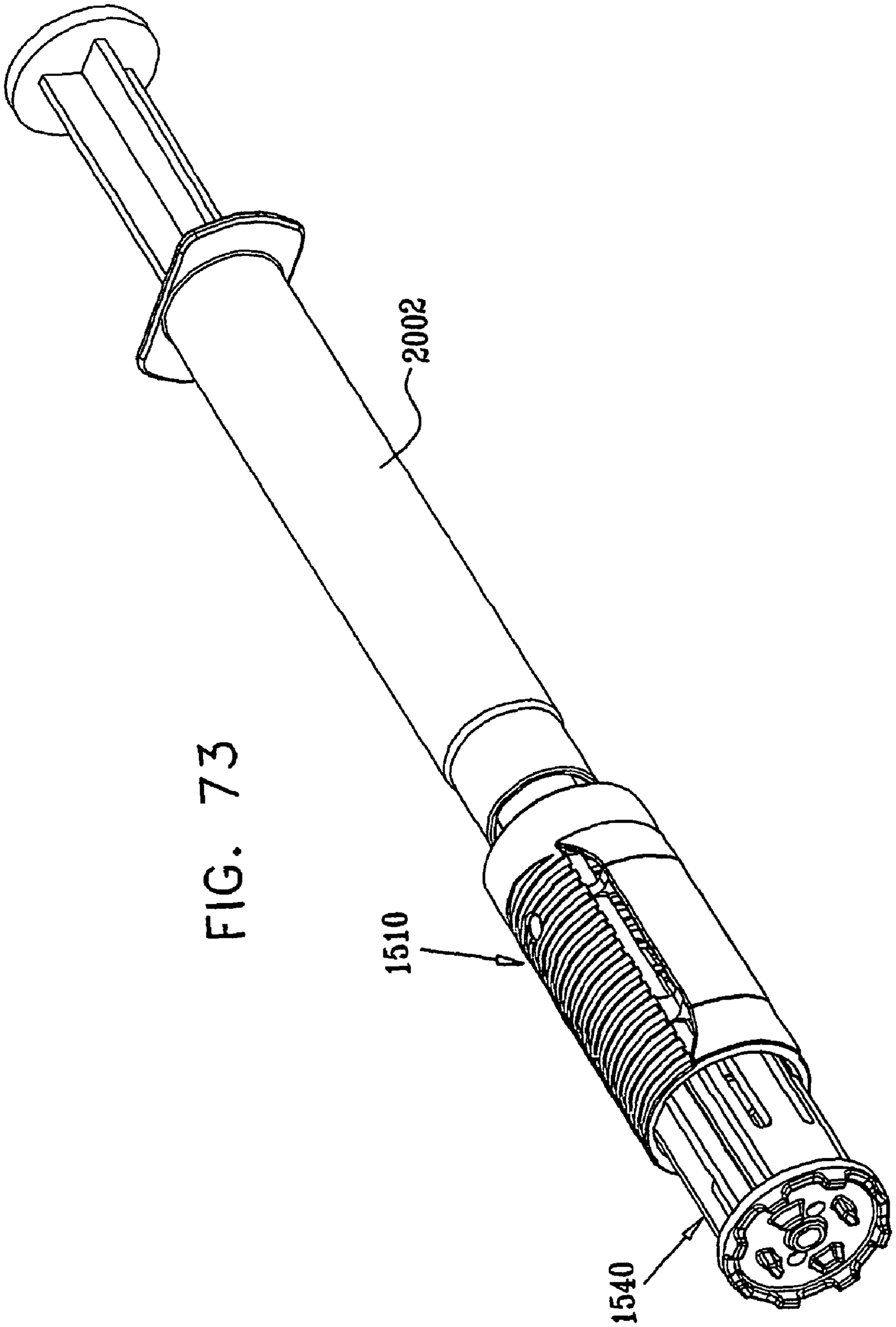


FIG. 73

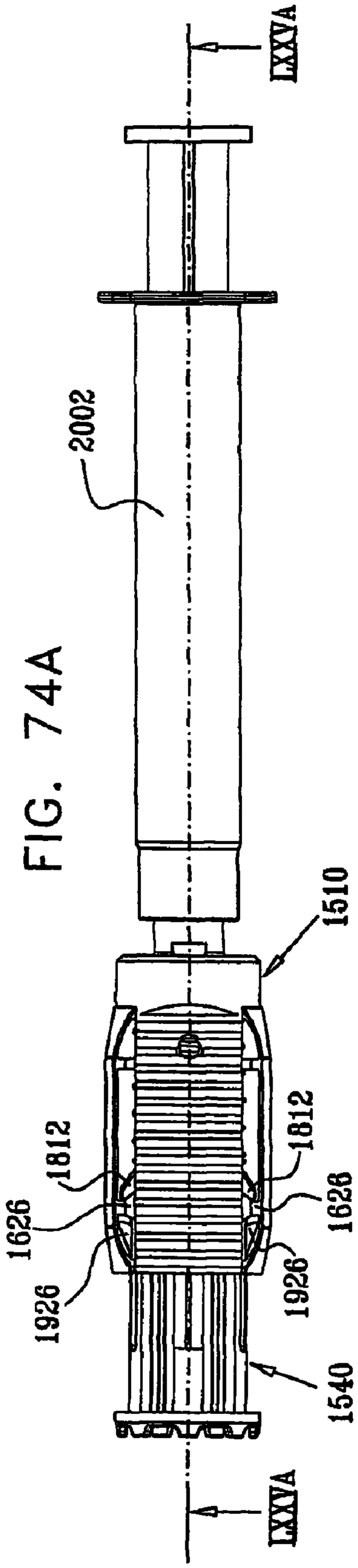


FIG. 74A

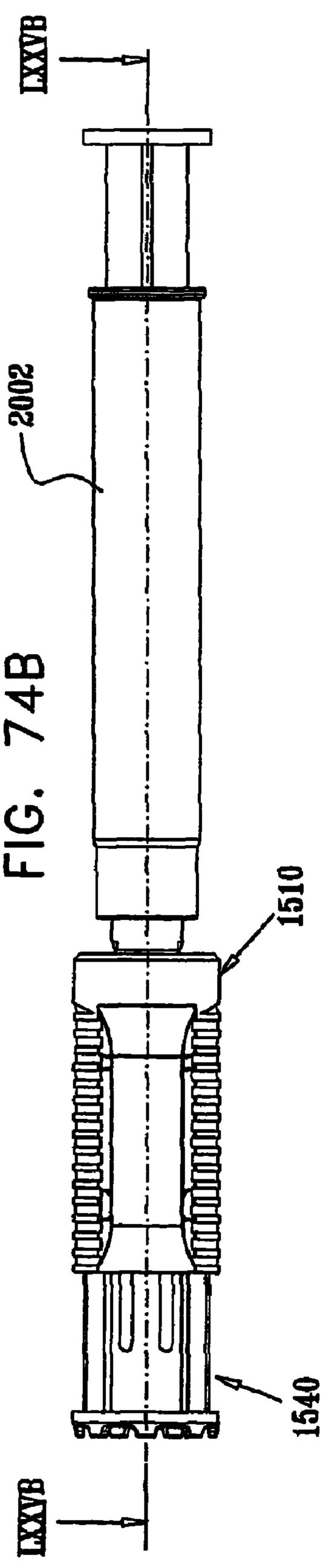


FIG. 74B

FIG. 75A

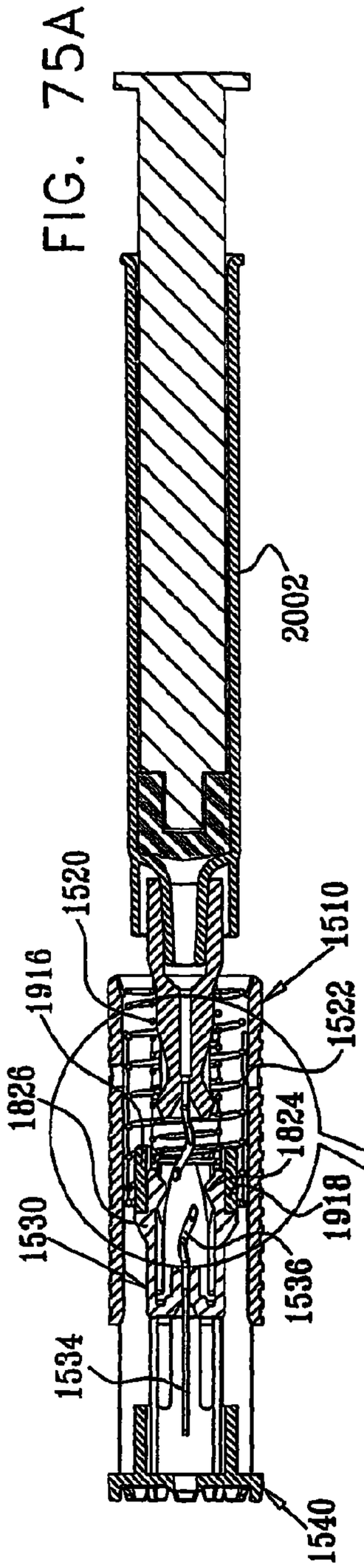
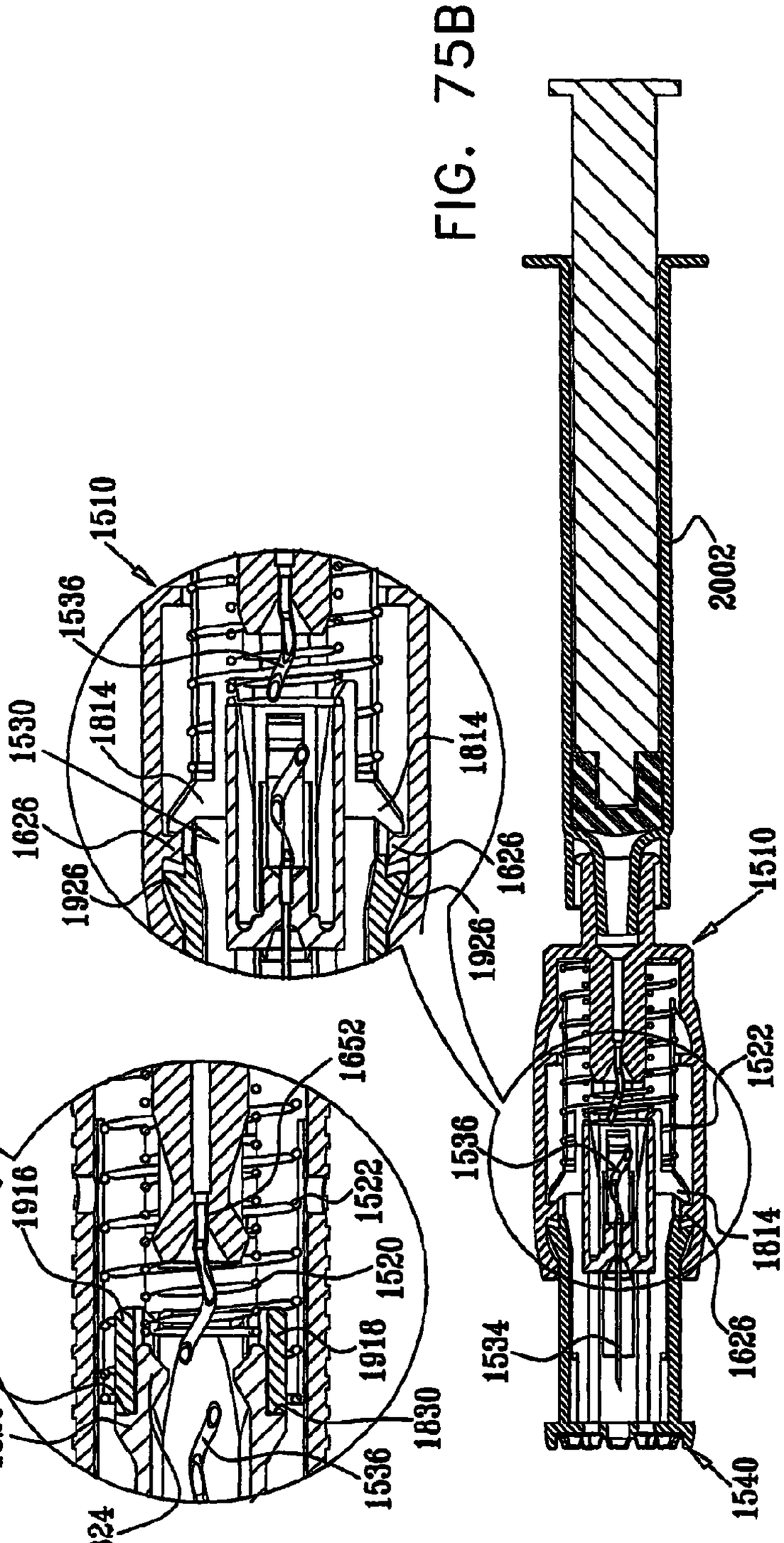


FIG. 75B



AUTOMATIC NEEDLE DEVICE

CROSS-REFERENCE TO PRIOR APPLICATION

The above-referenced application is the U.S. National Phase of International Patent Application No. PCT/IL2004/000852, filed Sep. 15, 2004, which claims priority from Israeli Patent Application No. 157984, filed Sep. 17, 2003, all of which are incorporated herein. The International Application was published Mar. 24, 2005 as WO 2005/025637 A2 under PCT article 21(2).

FIELD OF THE INVENTION

The present invention relates to automatic needle devices for hypodermic syringes generally.

BACKGROUND OF TH INVENTION

The following U.S. Patents are believed to represent the current state of the art:

4,474,572; 4,475,906; 4,484,910; 4,487,602; 4,505,710; 4,512,767; 4,515,590; 4,518,387; 4,529,401; 4,529,403; 4,530,695; 4,534,759; 4,547,189; 4,553,962; 4,573,970; 4,573,976; 4,578,061; 4,578,064; 4,580,561; 4,592,744; 4,594,073; 4,596,558; 4,597,753; 4,600,403; 4,601,708; 4,613,328; 4,620,540; 4,620,847; 4,624,660; 4,650,468; 4,658,830; 4,659,326; 4,664,651; 4,664,654; 4,666,436; 4,672,967; 4,681,565; 4,687,465; 4,687,467; 4,689,042; 4,699,614; 4,710,170; 4,723,937; 4,735,618; 4,738,663; 4,743,234; 4,744,955; 4,745,907; 4,747,829; 4,747,831; 4,753,636; 4,755,169; 4,758,227; 4,758,230; 4,758,231; 4,766,908; 4,767,407; 4,767,413; 4,770,655; 4,781,683; 4,781,685; 4,781,688; 4,784,640; 4,787,384; 4,787,893; 4,790,823; 4,790,827; 4,795,432; 4,795,433; 4,798,587; 4,799,921; 4,804,370; 4,808,169; 4,813,937; 4,813,940; 4,820,275; 4,820,286; 4,826,484; 4,826,489; 4,826,490; 4,828,548; 4,832,682; 4,832,693; 4,834,704; 4,834,718; 4,842,598; 4,846,811; 4,850,961; 4,850,968; 4,850,971; 4,850,976; 4,850,977; 4,850,994; 4,861,338; 4,863,427; 4,863,435; 4,863,436; 4,865,592; 4,874,372; 4,874,382; 4,883,466; 4,883,472; 4,886,499; 4,887,998; 4,892,107; 4,892,523; 4,894,054; 4,894,055; 4,898,589; 4,900,303; 4,900,307; 4,900,311; 4,902,279; 4,904,242; 4,906,236; 4,908,022; 4,909,794; 4,909,795; 4,911,706; 4,913,702; 4,915,702; 4,917,672; 4,919,146; 4,919,657; 4,923,443; 4,923,445; 4,927,414; 4,929,237; 4,929,241; 4,931,040; 4,932,944; 4,932,946; 4,932,947; 4,935,013; 4,935,014; 4,936,830; 4,941,879; 4,944,723; 4,944,725; 4,946,441; 4,950,240; 4,950,241; 4,950,250; 4,950,252; 4,955,866; 4,955,868; 4,955,869; 4,955,870; 4,961,728; 4,966,589; 4,966,592; 4,966,593; 4,973,310; 4,973,317; 4,976,704; 4,988,335; 4,988,339; 4,994,045; 4,998,921; 4,998,922; 5,000,736; 5,000,737; 5,002,548; 5,007,903; 5,011,475; 5,015,240; 5,017,187; 5,019,043; 5,019,044; 5,019,047; 5,019,048; 5,021,059; 5,024,665; 5,026,349; 5,030,208; 5,034,003; 5,037,306; 5,037,382; 5,037,393; 5,037,400; 5,041,094; 5,042,977; 5,045,066; 5,047,016; 5,049,133; 5,049,136; 5,053,010; 5,053,018; 5,055,102; 5,057,086; 5,057,089; 5,059,180; 5,059,185; 5,061,249; 5,061,251; 5,064,419; 5,067,490; 5,067,948; 5,071,353; 5,080,104; 5,084,027; 5,084,029; 5,084,030; 5,085,640; 5,085,641; 5,085,642; 5,088,986; 5,088,988; 5,092,843; 5,092,851; 5,092,852; 5,092,853; 5,098,382; 5,098,400; 5,098,401; 5,102,393; 5,102,397; 5,104,378; 5,104,380; 5,104,384; 5,104,385; 5,106,370; 5,106,372; 5,106,379; 5,108,378; 5,108,379; 5,112,307; 5,112,316; 5,114,404; 5,120,310; 5,120,314; 5,120,321; 5,122,118; 5,122,124; 5,125,898; 5,125,899; 5,127,910; 5,135,507; 5,135,510; 5,137,515; 5,137,516; 5,141,496; 5,143,414; 5,147,311; 5,147,326; 5,147,327; 5,149,323; 5,152,751; 5,156,599; 5,160,326; 5,163,916; 5,163,917; 5,163,918; 5,167,632; 5,167,641; 5,169,389; 5,169,392; 5,176,641; 5,176,655; 5,176,656; 5,176,657; 5,183,468; 5,183,469; 5,188,614; 5,190,526; 5,193,552; 5,195,982; 5,195,983; 5,195,985; 5,199,952; 5,201,708; 5,201,710; 5,205,826; 5,205,827; 5,207,646; 5,207,699; 5,209,739; 5,211,628; 5,211,629; 5,215,524; 5,215,533; 5,215,534; 5,215,535; 5,215,536; 5,217,437; 5,219,338; 5,221,262; 5,222,943; 5,222,947; 5,222,974; 5,224,936; 5,226,882; 5,228,883; 5,232,457; 5,232,458; 5,238,654; 5,242,388; 5,242,401; 5,242,416; 5,242,420; 5,246,428; 5,250,031; 5,256,152; 5,257,976; 5,261,894; 5,263,933; 5,267,961; 5,267,963; 5,269,761; 5,269,762; 5,269,766; 5,273,532; 5,273,538; 5,273,539; 5,273,541; 5,273,544; 5,279,554; 5,279,566; 5,279,577; 5,279,579; 5,279,581; 5,279,582; 5,279,583; 5,279,590; 5,282,793; 5,282,822; 5,282,827; 5,284,479; 5,290,233; 5,290,239; 5,290,240; 5,290,254; 5,292,314; 5,295,963; 5,295,965; 5,295,972; 5,295,973; 5,295,974; 5,295,975; 5,300,029; 5,300,030; 5,300,040; 5,300,045; 5,304,137; 5,304,138; 5,306,251; 5,306,258; 5,308,332; 5,311,841; 5,312,353; 5,312,366; 5,312,368; 5,312,370; 5,312,371; 5,312,372; 5,314,503; 5,318,538; 5,320,609; 5,322,517; 5,324,265; 5,328,475; 5,328,482; 5,328,484; 5,330,430; 5,334,149; 5,334,158; 5,334,173; 5,336,180; 5,336,187; 5,336,199; 5,338,303; 5,338,311; 5,342,310; 5,342,320; 5,344,407; 5,344,408; 5,346,475; 5,346,480; 5,346,481; 5,348,544; 5,352,200; 5,352,202; 5,352,203; 5,354,287; 5,356,387; 5,358,489; 5,360,410; 5,364,362; 5,364,370; 5,366,447; 5,368,568; 5,368,570; 5,368,571; 5,370,619; 5,370,626; 5,374,250; 5,378,240; 5,383,857; 5,385,550; 5,385,551; 5,385,557; 5,389,076; 5,389,085; 5,391,151; 5,391,183; 5,395,317; 5,395,337; 5,399,163; 5,401,246; 5,401,249; 5,401,251; 5,403,286; 5,403,287; 5,405,326; 5,405,327; 5,407,436; 5,409,466; 5,411,487; 5,415,638; 5,415,645; 5,415,648; 5,419,766; 5,419,773; 5,423,746; 5,425,715; 5,425,722; 5,429,611; 5,429,612; 5,429,613; 5,431,631; 5,431,632; 5,433,712; 5,445,618; 5,445,620; 5,451,210; 5,458,576; 5,458,580; 5,460,611; 5,462,531; 5,466,223; 5,468,227; 5,474,687; 5,478,314; 5,478,316; 5,478,328; 5,480,385; 5,480,387; 5,480,390; 5,482,039; 5,484,414; 5,486,163; 5,486,164; 5,487,732; 5,487,733; 5,487,734; 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5,899,885; 5,899,886; 5,908,404; 5,908,408; 5,910,131; 5,911,706; 5,919,166; 5,921,959; 5,921,960; 5,921,961; 5,921,963; 5,921,964; 5,925,019; 5,928,188; 5,928,194; 5,928,205; 5,931,813; 5,938,638; 5,938,639; 5,941,850; 5,944,692; 5,944,693; 5,951,522; 5,954,699; 5,957,892; 5,957,895; 5,957,897; 5,960,797; 5,961,491; 5,971,953; 5,976,111; 5,980,487; 5,980,488; 5,980,491; 5,980,494; 5,984,899; 5,984,900; 5,989,219; 5,989,221; 5,993,417; 5,993,418; 5,997,500; 5,997,511; 5,997,513; 6,001,080; 6,007,474; 6,010,486; 6,010,487; 6,015,396; 6,015,438; 6,017,325; 6,022,337; 6,033,386; 6,033,387; 6,036,674; 6,039,713; 6,050,974; 6,050,977; 6,056,716; 6,056,724; 6,056,734; 6,063,040; 6,063,053; 6,066,115; 6,068,616; 6,074,360; 6,074,369; 6,074,370; 6,077,245; 6,080,135; 6,083,199; 6,083,200; 6,086,562; 6,086,569; 6,090,077; 6,090,078; 6,090,080; 6,093,172; 6,099,500; 6,099,503; 6,099,504; 6,102,844; 6,113,574; 6,117,112; 6,117,113; 6,126,637; 6,129,710; 6,142,972; 6,149,626; 6,149,629; 6,156,008; 6,156,010; 6,156,013; 6,156,015; 6,159,161; 6,159,181; 6,159,185; 6,171,284; 6,179,812; 6,183,444; 6,183,446; 6,186,980; 6,192,891; 6,193,695; 6,206,856; 6,206,857; 6,210,369; 6,217,550; 6,217,559; 6,221,044; 6,221,051; 6,221,052; 6,224,576; 6,228,054; 6,228,055; 6,235,006; 6,241,707; 6,241,708; 6,254,575; 6,254,580; 6,258,056; 6,261,264; 6,261,265; 6,267,748; 6,270,472; 6,270,481; 6,273,870; 6,280,399; 6,280,420; 6,280,421; 6,283,941; 6,293,925; 6,299,601; 6,309,374; 6,309,375; 6,312,409; 6,315,113; 6,319,233; 6,319,234; 6,322,536; 6,325,781; 6,325,789; 6,331,173; 6,332,875; 6,344,031; 6,356,783; 6,361,525; 6,368,303; 6,371,938; 6,379,336; 6,387,078; 6,402,716; 6,409,701; 6,409,703; 6,409,706; 6,412,490; 6,413,236; 6,413,237; 6,416,323; 6,416,497; 6,419,658;

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5,279,577; 5,279,579; 5,279,581; 5,279,582; 5,279,583; 5,279,590; 5,282,793; 5,282,822; 5,282,827; 5,284,479; 5,290,233; 5,290,239; 5,290,240; 5,290,254; 5,292,314; 5,295,963; 5,295,965; 5,295,972; 5,295,973; 5,295,974; 5,295,975; 5,300,029; 5,300,030; 5,300,040; 5,300,045; 5,304,137; 5,304,138; 5,306,251; 5,306,258; 5,308,332; 5,311,841; 5,312,353; 5,312,366; 5,312,368; 5,312,370; 5,312,371; 5,312,372; 5,314,503; 5,318,538; 5,320,609; 5,322,517; 5,324,265; 5,328,475; 5,328,482; 5,328,484; 5,330,430; 5,334,149; 5,334,158; 5,334,173; 5,336,180; 5,336,187; 5,336,199; 5,338,303; 5,338,311; 5,342,310; 5,342,320; 5,344,407; 5,344,408; 5,346,475; 5,346,480; 5,346,481; 5,348,544; 5,352,200; 5,352,202; 5,352,203; 5,354,287; 5,356,387; 5,358,489; 5,360,410; 5,364,362; 5,364,370; 5,366,447; 5,368,568; 5,368,570; 5,368,571; 5,370,619; 5,370,626; 5,374,250; 5,378,240; 5,383,857; 5,385,550; 5,385,551; 5,385,557; 5,389,076; 5,389,085; 5,391,151; 5,391,183; 5,395,317; 5,395,337; 5,399,163; 5,401,246; 5,401,249; 5,401,251; 5,403,286; 5,403,287; 5,405,326; 5,405,327; 5,407,436; 5,409,466; 5,411,487; 5,415,638; 5,415,645; 5,415,648; 5,419,766; 5,419,773; 5,423,746; 5,425,715; 5,425,722; 5,429,611; 5,429,612; 5,429,613; 5,431,631; 5,431,632; 5,433,712; 5,445,618; 5,445,620; 5,451,210; 5,458,576; 5,458,580; 5,460,611; 5,462,531; 5,466,223; 5,468,227; 5,474,687; 5,478,314; 5,478,316; 5,478,328; 5,480,385; 5,480,387; 5,480,390; 5,482,039; 5,484,414; 5,486,163; 5,486,164; 5,487,732; 5,487,733; 5,487,734; 5,489,272; 5,492,536; 5,496,278; 5,501,672; 5,512,048; 5,512,050; 5,514,097; 5,514,107; 5,520,639; 5,520,649; 5,522,797; 5,522,812; 5,527,283; 5,527,284; 5,527,307; 5,529,189; 5,531,691; 5,531,692; 5,531,694; 5,531,704; 5,531,706; 5,533,975; 5,533,984; 5,536,243; 5,536,253; 5,536,257; 5,538,506; 5,538,508; 5,540,664; 5,540,666; 5,542,920; 5,542,927; 5,549,558; 5,549,568; 5,549,570; 5,549,572; 5,549,708; 5,558,648; 5,562,623; 5,562,624; 5,562,626; 5,562,631; 5,569,202; 5,569,203; 5,573,513; 5,575,770; 5,578,011; 5,578,014; 5,578,015; 5,582,591; 5,586,976; 5,591,133; 5,591,134; 5,591,138; 5,593,387; 5,593,390; 5,599,309; 5,599,313; 5,599,316; 5,599,318; 5,601,532; 5,601,535; 5,605,544; 5,609,577; 5,611,781; 5,611,782; 5,613,500; 5,613,951; 5,613,952; 5,615,771; 5,616,123; 5,616,132; 5,616,134; 5,616,135; 5,620,422; 5,620,425; 5,624,401; 5,624,405; 5,628,765; 5,630,803; 5,632,730; 5,632,733; 5,634,906; 5,634,909; 5,634,937; 5,637,092; 5,637,094; 5,643,220; 5,643,222; 5,647,851; 5,649,622; 5,651,774; 5,653,687; 5,653,688; 5,653,693; 5,656,031; 5,658,256; 5,658,257; 5,658,258; 5,658,259; 5,662,610; 5,662,617; 5,665,071; 5,665,075; 5,669,889; 5,672,155; 5,672,161; 5,681,291; 5,681,295; 5,688,240; 5,688,251; 5,693,016; 5,693,022; 5,693,023; 5,695,472; 5,704,911; 5,704,921; 5,707,393; 5,709,662; 5,709,667; 5,709,668; 5,713,866; 5,713,871; 5,713,872; 5,720,727; 5,725,498; 5,738,655; 5,741,223; 5,743,879; 5,743,887; 5,743,888; 5,743,891; 5,746,718; 5,749,854; 5,749,860; 5,755,692; 5,769,822; 5,769,827; 5,779,675; 5,779,677; 5,779,684; 5,788,677; 5,788,713; 5,792,107; 5,792,121; 5,792,122; 5,795,336; 5,797,885; 5,800,403; 5,807,334; 5,807,345; 5,807,352; 5,810,775; 5,810,784; 5,817,054; 5,817,070; 5,820,602; 5,823,997; 5,823,998; 5,827,293; 5,830,130; 5,836,911; 5,836,920; 5,843,036; 5,843,047; 5,848,990; 5,851,197; 5,853,390; 5,853,393; 5,855,839; 5,858,000; 5,865,227; 5,865,804; 5,868,711; 5,879,337; 5,882,342; 5,885,257; 5,891,052; 5,891,092; 5,891,097; 5,891,105; 5,897,508; 5,899,885; 5,899,886; 5,908,404; 5,908,408; 5,910,131; 5,911,706; 5,919,166; 5,921,959; 5,921,960; 5,921,961; 5,921,963; 5,921,964; 5,925,019; 5,928,188; 5,928,194; 5,928,205; 5,931,813; 5,938,638; 5,938,639; 5,941,850; 5,944,692; 5,944,693; 5,951,522; 5,954,699; 5,957,892; 5,957,895; 5,957,897; 5,960,797; 5,961,491; 5,971,953; 5,976,111; 5,980,487; 5,980,488; 5,980,491; 5,980,494; 5,984,899; 5,984,900; 5,989,219; 5,989,221; 5,993,417; 5,993,418; 5,997,500; 5,997,511; 5,997,513; 6,001,080; 6,007,474; 6,010,486; 6,010,487; 6,015,396; 6,015,438; 6,017,325; 6,022,337; 6,033,386; 6,033,387; 6,036,674; 6,039,713; 6,050,974; 6,050,977; 6,056,716; 6,056,724; 6,056,734; 6,063,040; 6,063,053; 6,066,115; 6,068,616; 6,074,360; 6,074,369; 6,074,370; 6,077,245; 6,080,135; 6,083,199; 6,083,200; 6,086,562; 6,086,569; 6,090,077; 6,090,078; 6,090,080; 6,093,172; 6,099,500; 6,099,503; 6,099,504; 6,102,844; 6,113,574; 6,117,112; 6,117,113; 6,126,637; 6,129,710; 6,142,972; 6,149,626; 6,149,629; 6,156,008; 6,156,010; 6,156,013; 6,156,015; 6,159,161; 6,159,181; 6,159,185; 6,171,284; 6,179,812; 6,183,444; 6,183,446; 6,186,980; 6,192,891; 6,193,695; 6,206,856; 6,206,857; 6,210,369; 6,217,550; 6,217,559; 6,221,044; 6,221,051; 6,221,052; 6,224,576; 6,228,054; 6,228,055; 6,235,006; 6,241,707; 6,241,708; 6,254,575; 6,254,580; 6,258,056; 6,261,264; 6,261,265; 6,267,748; 6,270,472; 6,270,481; 6,273,870; 6,280,399; 6,280,420; 6,280,421; 6,283,941; 6,293,925; 6,299,601; 6,309,374; 6,309,375; 6,312,409; 6,315,113; 6,319,233; 6,319,234; 6,322,536; 6,325,781; 6,325,789; 6,331,173; 6,332,875; 6,344,031; 6,356,783; 6,361,525; 6,368,303; 6,371,938; 6,379,336; 6,387,078; 6,402,716; 6,409,701; 6,409,703; 6,409,706; 6,412,490; 6,413,236; 6,413,237; 6,416,323; 6,416,497; 6,419,658;

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6,428,463; 6,428,517; 6,432,035; 6,432,082; 6,432,087; 6,436,068; 6,440,098; 6,443,929; 6,447,480; 6,454,743; 6,458,105; 6,461,331; 6,461,333; 6,468,247; 6,475,194; 6,478,780; 6,482,176; 6,485,469; 6,485,474; 6,494,863; 6,500,155; 6,508,755; 6,511,454; 6,514,230; 6,517,516; 6,517,517; 6,524,278; 6,527,734; 6,527,742; 6,530,896; 6,530,904; 6,537,249; 6,537,252; 6,544,234; 6,547,764; 6,551,275; 6,551,276; 6,551,278; 6,554,798; 6,558,351; 6,558,357; 6,565,533; 6,565,538; 6,569,115; 6,572,584; 6,572,585; 6,575,939; 6,579,256; 6,582,405; 6,584,910; 6,585,690; 6,585,693; 6,585,702; 6,589,158; 6,592,508; 6,592,555; 6,592,556; 6,595,962; 6,599,268; 6,599,269; 6,599,272; 6,605,058; 6,605,067; 6,605,073; 6,607,508; 6,607,509; 6,613,019; 6,613,022; 6,616,630; 6,616,638; 6,616,639; 6,620,136; 6,620,137; 6,620,138; 6,623,455; 6,623,458; 6,623,459; 6,626,864; 6,629,957; 6,629,959; 6,632,198; 6,637,587; 6,638,248; 6,638,255; 6,641,561; 6,645,181; 6,652,482; 6,656,164; 6,659,975; 6,659,982; 6,663,593; 6,669,666; 6,673,034; 6,673,044; 6,673,049; 6,678,550; 6,679,863; 6,679,864; 6,685,676; 6,685,677; 6,689,091; 6,689,106; 6,689,107; 6,689,108; 6,692,470; 6,692,471; 6,699,218; 6,702,784; 6,706,011; 6,706,015; 6,706,019; 6,709,416; 6,712,787; 6,712,788; 6,716,191; 6,716,197; 6,716,198; 6,719,721; 6,719,728; 6,719,730; 6,723,068; 6,723,072; 6,726,655; 6,726,658; 6,726,661; 6,726,662; 6,730,059; 6,736,800; 6,740,059; 6,743,203; 6,749,833; 6,752,782; 6,752,784; 6,752,798; 6,761,706; 6,767,336; RE 33,585; RE 34,335; RE 34,936; RE 36,398; RE 36,447; RE 37,110; RE 37,252 and RE 37,487.

SUMMARY OF THE INVENTION

The present invention seeks to provide an improved automatic needle device. There is thus provided in accordance with a preferred embodiment of the present invention an automatic needle device including a housing element, at least one resilient element arranged to be located within the housing element, at least one needle bearing element adapted, when actuated, to be displaced by the at least one resilient element with respect to the housing element from a non-penetration position to a penetration position and a needle guard adapted for positioning with respect to the housing element and wherein displacement of the needle guard is operative to actuate displacement of the at least one needle bearing element from the non-penetration position to the penetration position.

Preferably, rearward displacement of the needle guard is operative to actuate displacement of the at least one needle bearing element from the non-penetration position to the penetration position.

Preferably, the automatic needle device also includes a safety element adapted to prevent inadvertent actuation of displacement of the at least one needle bearing element. Additionally, the safety element prevents inadvertent rearward displacement of the needle guard.

Preferably, of the present invention the at least one resilient element includes a unitary resilient element. Alternatively, the at least one resilient element includes first and second coil springs.

Preferably, the housing element includes an injection device engagement portion. Additionally, the housing element and the at least one needle bearing element together define a fluid pathway from the injection device engagement portion through the needle at least when the needle bearing element is in both the non-penetration position and the penetration position.

Preferably, the needle guard is displaceable by the at least one resilient element.

Preferably, the at least one resilient element includes first and second compression springs which provide selectable forward displacement to the at least one needle bearing element.

Preferably, the needle bearing element includes a hub portion and a needle adhered thereto and extending through a septum.

Preferably, the automatic needle device also includes a safety tab operative for disabling actuation of the automatic needle device. In accordance with yet another preferred embodiment of the present invention, the safety tab includes a spacer portion and a tab portion.

There is also provided in accordance with another preferred embodiment of the present invention an automatic needle device including a housing element, at least one needle bearing element adapted, when actuated, to be displaced with respect to the housing element from a non-penetration position to a penetration position and a needle guard adapted for positioning with respect to the at least one needle bearing element in a mutually locked needle guarding orientation, whereby displacement of the needle guard relative to the housing requires corresponding displacement of the at least one needle bearing element.

There is further provided in accordance with yet another preferred embodiment of the present invention an automatic needle device including a housing element, at least one needle bearing element adapted, when actuated, to be displaced with respect to the housing element from a non-penetration position to a penetration position and a needle guard adapted for positioning with respect to the at least one needle bearing element and with respect to the housing element in a mutually locked needle guarding orientation, whereby displacement of the needle guard in a first direction relative to the housing is prevented by engagement of the needle guard with the at least one needle bearing element and displacement of the needle guard in a second direction relative to the housing, opposite to the first direction, is prevented by engagement of the needle guard with the housing element.

There is even further provided in accordance with still another preferred embodiment of the present invention an automatic needle device including a housing element adapted to be connected to an external injection device, at least one needle bearing element adapted, when actuated, to be displaced with respect to the housing element from a non-penetration position to a penetration position and a needle guard adapted for positioning with respect to at least one of the at least one needle bearing element and the housing element in a needle guarding orientation.

There is still further provided in accordance with another preferred embodiment of the present invention an injection device including a housing element, a unitary resilient element arranged to be located within the housing element, the unitary resilient element including a septum portion and at least one displacement actuating portion, and at least one needle bearing element including a needle sealingly engaging the septum portion, the at least one needle bearing element adapted, when actuated, to be displaced by the at least one displacement actuating portion of the unitary resilient element with respect to the housing element from a non-penetration position to a penetration position.

Preferably, the housing element is an integrally formed element having a generally cylindrical configuration and is generally top-to-bottom and side-to-side symmetric about a longitudinal axis. Alternatively or additionally, the housing element includes a rearward generally tubular portion which terminates in an open back and defines forwardly thereof a generally cylindrical portion, whose outer configuration includes top and bottom grip regions. Additionally or alternatively, the housing element includes first and second forwardly and rearwardly tapered side protrusions.

Preferably, the automatic needle device also includes, at an inner surface of the generally cylindrical portion, forward and rearward inwardly extending transverse ribs and a plurality of inwardly extending longitudinal slots.

Preferably, the automatic needle device also includes, at an interior of the generally tubular portion, a generally cylindrical bore which communicates via a tapered interface with a forward bore, disposed interiorly of the cylindrical portion, the cylindrical bore being arranged to receive a septum.

Preferably, apertures are formed in cylindrical walls of the cylindrical bore in alignment along a line extending transversely to a longitudinal axis of the housing element.

Preferably, a forward-facing back wall surface of the generally cylindrical portion defines a seat for the at least one resilient element.

Preferably the housing element is formed with a pair of side-to-side symmetric windows, to allow viewing the tip of a needle held by the needle bearing element.

In accordance with another preferred embodiment of the present invention the needle bearing element includes a needle hub and a needle. Additionally, the needle bearing element has a generally cylindrical configuration and is top-to-bottom and side-to-side symmetric about a longitudinal axis. Additionally or alternatively, the needle bearing element defines a generally tubular body having formed thereon a pair of up-down mutually spaced, forwardly facing, outwardly extending hook protrusions. In accordance with another preferred embodiment of the present invention the protrusions are each associated with a rearward facing rib.

Preferably, a rearwardly extending arm is formed at both a top and a bottom of the tubular body, each arm including, adjacent an extreme rearwardly facing end thereof, a tapered inwardly facing tooth and forwardly thereof an outwardly facing tooth, having a transversely extending rearwardly facing surface.

Preferably top and bottom pairs of outwardly facing ribs are formed on the tubular portion, adjacent respective rearward facing ribs, the outwardly facing nibs being operative to slidably locate the needle bearing element within the needle guard.

Preferably, the tubular body defines a generally open back and a forward facing wall portion adjacent in which is formed a recess, which communicates with a narrow axial bore, arranged to receive the needle, which extends therethrough.

Preferably, a rearward facing external wall portion, located at a rearward end of the tubular body, defines a seat for the at least one resilient element.

In accordance with yet a further preferred embodiment of the present invention the needle guard has a generally cylindrical configuration and is top-to-bottom and side-to-side symmetric about a longitudinal axis. Additionally or alternatively, the needle guard defines a generally tubular body having formed thereon a plurality of circumferentially spaced, longitudinally extending, outward facing ribs, having rearward facing ends, the outward facing ribs being adapted to slidably locate the needle guard within inwardly extending longitudinal slots of the housing element.

Preferably, extending rearwardly of the outwardly facing ribs there is provided a curved rearward facing portion having a pair of inwardly facing ribs formed therein, and, extending rearwardly of the ribs, there is formed a symmetrically curved rearward facing portion having a pair of ribs formed therein. Additionally or alternatively, the curved rearward facing portions together with the rearward facing ends define a seat for a spring forming part of the at least one resilient element.

Preferably, the inwardly facing ribs are operative to slidably locate the needle bearing element within the needle guard, by allowing the outwardly facing ribs to slide therein.

Preferably, a rearwardly extending arm is formed at each side of the tubular body, each of the arms including adjacent an extreme rearwardly facing end thereof, an outwardly facing tooth, having an inclined forward surface and a transversely extending rearwardly facing surface. Additionally or alternatively, the tubular body defines a generally open back and a forward facing wall portion, defining an injection site engagement surface.

Preferably, the injection site engagement surface includes a pair of mutually concentric circles of mutually spaced forwardly extending protrusions and the forward facing wall portion is formed with an axial bore, arranged to allow a needle to extend therethrough.

Preferably, the needle guard is formed with a pair of side-to-side symmetric windows, to allow viewing of the tip of a needle.

Preferably, in a pre-use operative orientation suitable for storage, the housing element is joined to the needle bearing element by snap fit engagement of inner facing teeth formed on the needle bearing element into apertures formed in cylindrical walls of the housing element.

Preferably the at least one resilient element includes first and second compression springs, the first compression spring being maintained under compression between forward-facing back wall surface of a generally cylindrical portion of the housing element and a rearward facing wall portion of the needle bearing element and the second compression spring being maintained under compression between the forward facing back wall surface and rearward facing ends of the needle guard, which is slidably retained against disassembly forward movement by the positioning of curved rearward facing portions thereof immediately rearward of the inner facing teeth of the needle bearing element

Preferably, the needle bearing element is retained in its place by engagement of rearwardly outwardly facing surfaces of the inner facing teeth with curved rearward facing portions of the needle guard, thus preventing rearwardly extending arms of the needle bearing element from bending outwardly and releasing the snap fit engagement of the inner facing teeth and apertures formed in the cylindrical walls of the cylindrical bore of the housing element. Additionally or alternatively, due to engagement of the needle guard with an injection site on a body, the needle guard is forced, against the urging of the at least one resilient element, to move axially in a rearward direction with respect to the remainder of the automatic needle device, thus sliding the curved rearward facing portions thereof further rearward of the outwardly facing teeth of the needle bearing element, thus allowing the arms of the needle bearing element to cantilever outwardly.

Preferably, at all times the needle sealingly and slidably engages a septum.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be understood and appreciated more fully from the following detailed description, taken in conjunction with the drawings in which:

FIG. **1** is a simplified exploded view illustration of an automatic needle device constructed and operative in accordance with a preferred embodiment of the present invention;

FIGS. **2**A and **2**B are simplified pictorial illustrations of a housing element which forms part of the automatic needle device of FIG. **1**;

FIGS. **3**A and **3**B are respective top and side view simplified planar illustrations of the housing element of FIGS. **2**A and **2**B;

FIGS. **4**A, **4**B are sectional illustrations taken along respective section lines and directions IVA-IVA and IVB-IVB in FIGS. **3**A and **3**B;

FIGS. **5**A and **5**B are pictorial sectional illustrations taken along respective section lines and directions VA-VA and VB-VB in FIG. **2**A;

FIGS. **6**A and **6**B are simplified pictorial illustrations of a needle hub assembly which forms part of the automatic needle device of FIG. **1**;

FIGS. **7**A and **7**B are respective top and side view simplified planar illustrations of the needle hub assembly of FIGS. **6**A and **6**B;

FIGS. **8**A and **8**B are sectional illustrations taken along respective section lines and directions VIIIA-VIIIA and VIIIB-VIIIB in FIGS. **7**A and **7**B;

FIGS. **9**A and **9**B are pictorial sectional illustrations taken along respective section lines and directions IXA-IXA and IXB-IXB in FIG. **6**A;

FIGS. **10**A and **10**B are simplified pictorial illustrations of a needle guard element which forms part of the automatic needle device of FIG. **1**;

FIGS. **11**A and **11**B are respective top and side view simplified planar illustrations of the needle guard element of FIGS. **10**A and **10**B;

FIGS. **12**A and **12**B are sectional illustrations taken along respective section lines and directions XIIA-XIIA and XIIB-XIIB in FIGS. **11**A and **11**B;

FIGS. **13**A and **13**B are pictorial sectional illustrations taken along respective section lines and directions XIIIA-XIIIA and XIIIB-XIIIB in FIG. **10**A;

FIGS. **14**A, **14**B, **14**C and **14**D are simplified pictorial illustration of typical use of the automatic needle device of FIG. **1**;

FIGS. **15**A and **15**B are simplified assembled view illustrations of the automatic needle device of FIGS. **1** and **14**A in a pre-use operative orientation;

FIGS. **16**A and **16**B are respective top and side view simplified planar illustrations of the automatic needle device of FIGS. **15**A and **15**B;

FIGS. **17**A and **17**B are sectional illustrations taken along respective section lines and directions XVIIA-XVIIA and XVIIB-XVIIB in FIGS. **16**A and **16**B;

FIG. **18** is a simplified pictorial illustration of the automatic needle device of FIGS. **1** and **14**B in an injection site engagement operative orientation coupled to a syringe;

FIGS. **19**A and **19**B are respective top and side view simplified planar illustrations of the automatic needle device of FIG. **18** coupled to a syringe

FIGS. **20**A and **20**B are sectional illustrations taken along respective section lines and directions XXA-XXA and XXB-XXB in FIGS. **19**A and **19**B;

FIG. **21** is a simplified pictorial illustration of the automatic needle device of FIGS. **1** and **14**C in a needle actuated operational orientation;

FIGS. **22**A and **22**B are respective top and side view simplified planar illustrations of the automatic needle device of FIG. **21**;

FIGS. **23**A and **23**B are sectional illustrations taken along respective section lines and directions XXIIIA-XXIIIA and XXIIIB-XXIIIB in FIGS. **22**A and **22**B;

FIG. **24** is a simplified pictorial illustration of the automatic needle device of FIGS. **1** and **14**D in a post-drug delivery, needle guarded operative orientation;

FIGS. **25**A and **25**B are respective top and side view simplified planar illustrations of the automatic needle device of FIG. **24**;

FIGS. **26**A and **26**B are sectional illustrations taken along respective section lines and directions XXVIA-XXVIA and XXVIB-XXVIB in FIGS. **25**A and **25**B;

FIG. **27** is a simplified exploded view illustration of an automatic needle device constructed and operative in accordance with another preferred embodiment of the present invention;

FIGS. **28**A and **28**B are simplified pictorial illustrations of a housing element which forms part of the automatic needle device of FIG. **27**;

FIGS. **29**A and **29**B are simplified pictorial sectional illustrations of the housing element of FIGS. **28**A and **28**B taken along lines XXIXA-XXIXA and XXIXB-XXIXB in FIG. **28**A;

FIGS. **30**A and **30**B are respective top and side view simplified planar illustrations of the housing element of FIGS. **28**A-**29**B;

FIGS. **31**A, **31**B and **31**C are sectional illustrations taken along respective section lines and directions XXXIA-XXXIA, XXXIB-XXXIB and XXXIC-XXXIC in FIGS. **30**A and **30**B;

FIGS. **32**A and **32**B are simplified pictorial illustrations of a resilient element which forms part of the automatic needle device of FIG. **27**;

FIGS. **33**A and **33**B are simplified pictorial sectional illustrations of the resilient element of FIGS. **32**A and **32**B taken along lines XXXIIIA-XXXIIIA and XXXIIIB-XXXIIIB in FIG. **32**A;

FIGS. **34**A and **34**B are respective top and side view simplified planar illustrations of the resilient element of FIGS. **32**A-**33**B;

FIGS. **35**A and **35**B are sectional illustrations taken along respective section lines and directions XXXVA-XXXVA and XXXVB-XXXVB in FIGS. **34**A and **34**B;

FIGS. **36**A and **36**B are simplified pictorial illustrations of a needle hub assembly which forms part of the automatic needle device of FIG. **27**;

FIGS. **37**A and **37**B are simplified pictorial sectional illustrations of the needle hub assembly of FIGS. **36**A and **36**B taken along lines XXXVIIA-XXXVIIA and XXXVIIB-XXXVIIB in FIG. **36**A;

FIGS. **38**A and **38**B are respective top and side view simplified planar illustrations of the needle hub assembly of FIGS. **36**A-**37**B;

FIGS. **39**A and **39**B are sectional illustrations taken along respective section lines and directions XXXIXA-XXXIXA and XXXIXB-XXXIXB in FIGS. **38**A and **38**B;

FIGS. **40**A and **40**B are simplified pictorial illustrations of a needle guard element which forms part of the automatic needle device of FIG. **27**;

FIGS. **41**A and **41**B are simplified pictorial sectional illustrations of the needle guard element of FIGS. **40**A and **40**B taken along the lines XLIA-XLIA and XLIB-XLIB in FIG. **40**A;

FIGS. **42**A and **42**B are respective top and side view simplified planar illustrations of the needle guard element of FIGS. **40**A-**41**B;

FIGS. **43**A, **43**B and **43**C are sectional illustrations taken along respective section lines and directions XLIIIA-XLIIIA, XLIIIB-XLIIIB and XLIIIC-XLIIIC in FIGS. **42**A and **42**B;

FIGS. **44**A, **44**B, **44**C, **44**D, **44**E and **44**F are simplified pictorial illustrations of typical use of the automatic needle device of FIG. **27**;

FIG. **45** is a simplified assembled view pictorial illustration of the automatic needle device of FIGS. **27** and **44**A in a pre-use operative orientation, coupled to a syringe and prior to removal of a safety tab;

FIGS. **46**A and **46**B are respective top and side view simplified planar illustrations of the automatic needle device of FIG. **45**;

FIGS. **47**A and **47**B are sectional illustrations taken along respective section lines and directions XLVIIA-XLVIIA and XLVIIB-XLVIIB in FIGS. **46**A and **46**B;

FIG. **47**C is simplified illustration corresponding to FIG. **46**A with the needle guard element hidden;

FIG. **47**D is a partially cut-away illustration of the needle guard element and the needle hub assembly of FIG. **46**B;

FIG. **48** is a simplified pictorial illustration of the automatic needle device of FIGS. **27** and **44**B in an injection site engagement operative orientation following removal of the safety tab;

FIGS. **49**A and **49**B are respective top and side view simplified planar illustrations of the automatic needle device of FIG. **48**;

FIGS. **50**A and **50**B are sectional illustrations taken along respective section lines and directions LA-LA and LB-LB in FIGS. **49**A and **49**B;

FIG. **50**C is simplified illustration corresponding to FIG. **49**A with the needle guard element hidden;

FIG. **50**D is a partially cut-away illustration of the needle guard element and the needle hub assembly of FIG. **49**B;

FIG. **51** is a simplified pictorial illustration of the automatic needle device of FIGS. **27** and **44**C in a needle actuated operational orientation;

FIGS. **52**A and **52**B are respective top and side view simplified planar illustrations of the automatic needle device of FIG. **51**;

FIGS. **53**A and **53**B are sectional illustrations taken along respective section lines and directions LIIIA-LIIIA and LIIIB-LIIIB in FIGS. **52**A and **52**B;

FIG. **53**C is a simplified illustration of FIG. **52**A with the needle guard element hidden;

FIG. **53**D, is a partially cut-away illustration corresponding to the needle guard element and the needle hub assembly of FIG. **52**B;

FIG. **54** is a simplified pictorial illustration of the automatic needle device of FIGS. **27** and **44**D in an immediate post drug delivery operative orientation;

FIGS. **55**A and **55**B are respective top and side view simplified planar illustrations of the automatic needle device of FIG. **54**;

FIGS. **56**A and **56**B are sectional illustrations taken along respective section lines and directions LVIA-LVIA and LVIB-LVIB in FIGS. **55**A and **55**B;

FIG. **56**C is a simplified illustration corresponding to FIG. **55**A with the needle guard element hidden;

FIG. **56**D is a partially cut-away illustration of the needle guard element and the needle hub assembly of FIG. **55**B;

FIG. **57** is a simplified pictorial illustration of the automatic needle device of FIGS. **27** and **44**E in a post-drug delivery, needle guarded operative orientation;

FIGS. **58**A and **58**B are respective top and side view simplified planar illustrations of the automatic needle device of FIG. **57**;

FIGS. **59**A and **59**B are sectional illustrations taken along respective section lines and directions LIXA-LIXA and LIXB-LIXB in FIGS. **58**A and **58**B;

FIG. **59**C is a simplified illustration corresponding to FIG. **58**A with the needle guard element hidden;

FIG. **59**D is a partially cut-away illustration of the needle guard element and the needle hub assembly of FIG. **58**B;

FIG. **60** is a simplified pictorial illustration of the automatic needle device of FIGS. **27** and **44**F in a needle guard pushed back misuse operative orientation;

FIGS. **61**A and **61**B are respective top and side view simplified planar illustrations of the automatic needle device of FIG. **60**;

FIGS. **62**A and **62**B are sectional illustrations taken along respective section lines and directions LXIIA-LXIIA and LXIIB-LXIIB in FIGS. **61**A and **61**B;

FIG. **62**C is simplified illustration corresponding to FIG. **61**A with the needle guard element hidden;

FIG. **62**D is a partially cut-away of the needle guard element and the needle hub assembly of FIG. **61**B;

FIG. **63** is a simplified exploded view illustration of an automatic needle device constructed and operative in accordance with yet another preferred embodiment of the present invention, which is a modified version of the embodiment of FIGS. **1-26**;

FIGS. **64**A and **64**B are simplified assembled view illustrations of the automatic needle device of FIG. **63** in a pre-use operative orientation;

FIGS. **65**A and **65**B are respective top and side view simplified planar illustrations of the automatic needle device of FIGS. **64**A and **64**B;

FIGS. **66**A and **66**B are sectional illustrations taken along respective section lines and directions LXVIA-LXVIA and LXVIB-LXVIB in FIGS. **65**A and **65**B;

FIG. **67** is a simplified pictorial illustration of the automatic needle device of FIG. **63** in an injection site engagement operative orientation coupled to a syringe;

FIGS. **68**A and **68**B are respective top and side view simplified planar illustrations of the automatic needle device of FIG. **67** coupled to a syringe

FIGS. **69**A and **69**B are sectional illustrations taken along respective section lines and directions LXIXA-LXIXA and LXIXB-LXIXB in FIGS. **68**A and **68**B;

FIG. **70** is a simplified pictorial illustration of the automatic needle device of FIG. **63** in a needle actuated operational orientation;

FIGS. **71**A and **71**B are respective top and side view simplified planar illustrations of the automatic needle device of FIG. **70**;

FIGS. **72**A and **72**B are sectional illustrations taken along respective section lines and directions LXXIIA-LXXIIA and LXXIIB-LXXIIB in FIGS. **71**A and **71**B;

FIG. **73** is a simplified pictorial illustration of the automatic needle device of FIG. **63** in a post-drug delivery, needle guarded operative orientation;

FIGS. **74**A and **74**B are respective top and side view simplified planar illustrations of the automatic needle device of FIG. **73**; and

FIGS. **75**A and **75**B are sectional illustrations taken along respective section lines and directions LXXVA-LXXVA and LXXVB-LXXVB in FIGS. **74**A and **74**B.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Reference is now made to FIGS. **1-13**B, which illustrate the constituent elements of an automatic needle device constructed and operative in accordance with a preferred embodiment of the present invention.

As seen with particular clarity in FIG. **1**, the automatic needle device comprises a housing element **10** into which are generally coaxially seated respective first and second com-

pression springs **20** and **22**, which provide selectable forward displacement to a needle hub assembly **30**, which includes a hub portion **32** and a needle **34** adhesively adhered thereto and extending rearwardly through a septum **36**, and to a needle guard element **40**. Alternatively, needle hub portion **32** may be injected onto the needle, by a method such as insert molding.

A safety tab **60** including a tubular portion **62** and a tab portion **64** is preferably mounted onto the forward section of housing element **10**, thus disabling actuation of the automatic needle device. The automatic needle device is only functional once the safety tab is removed, as described hereinbelow.

It will be appreciated by persons skilled in the art that safety tab **60** can be formed of any suitable material, for example such as polypropylene, and may designed in many different shapes, such as a portion which is inserted into a slot between the needle guard element **40** and the housing element **10**, as a stand alone injection molded part, or as an integral part of any suitable part of the automatic needle device such as the housing element **10** as described e.g. hereinbelow with reference to FIGS. **27-62**D, the needle guard element **40** or the needle hub **32**.

It will additionally be appreciated by those skilled in the art that compression springs **20** and **22** may be replaced with a resilient element as described hereinbelow with reference to FIGS. **27-62**D. Alternatively, compression springs **20** and **22** may be replaced by tension springs, elastomeric compression springs or plastic springs which may be integrated into housing element **10**, into needle hub portion **32** or into needle guard element **40**.

Reference is now made to FIGS. **2**A and **2**B, which are simplified pictorial illustrations of a preferred housing element **10** which forms part of the automatic needle device of FIG. **1**, to FIGS. **3**A and **3**B are respective top and side view simplified planar illustrations thereof to FIGS. **4**A and **4**B which are sectional illustrations taken along respective section lines and directions IVA-IVA and IVB-IVB in FIGS. **3**A and **3**B and to FIGS. **5**A and **5**B which are pictorial sectional illustrations taken along respective section lines and directions VA-VA and VB-VB in FIG. **2**A.

As seen in FIGS. **2**A-**5**B, the housing element **10** preferably is an integrally formed element, preferably injection molded of plastic. Housing element **10** preferably has a generally cylindrical configuration and is preferably top-to-bottom and side-to-side symmetric about a longitudinal axis **100**.

Housing element **10** preferably includes a rearward generally tubular portion **110**, which terminates in an open back and defines generally symmetric side-facing tabs **114**. Forward of rearward generally tubular portion **110** there is provided a generally cylindrical portion **118**, whose outer configuration preferably includes top and bottom grip regions **120**, which are ribbed in a direction transverse to longitudinal axis **100** and first and second forwardly and rearwardly tapered side protrusions **122**.

At an inner surface of generally cylindrical portion **118** there are provided forward and rearward inwardly extending transverse ribs **126** and **128** and a plurality of inwardly extending longitudinal slots **130**. The interior of tubular portion **110** defines a generally cylindrical bore **134**. Bore **134** communicates via a tapered interface with a forward bore **136**, disposed interiorly of cylindrical portion **118**, which is arranged to receive septum **36**. Bore **136** has a circular cross section which is slightly smaller than that of bore **134**.

Apertures **144** are formed in the cylindrical walls of bore **136** in alignment along a line extending transversely to longitudinal axis **100**. A forward-facing back wall surface **154** of generally cylindrical portion **118** defines a spring seat for springs **20** and **22**.

The housing element **10** may optionally be formed with a pair of side-to-side symmetric windows, to allow viewing of the tip of the needle **34**, for example, when purging air bubbles from syringe **50**. Alternatively, housing element **10** may be formed of a transparent material.

Reference is now made to FIGS. **6**A and **6**B, which are simplified pictorial illustrations of a needle hub assembly **30** which forms part of the automatic needle device of FIG. **1**, to FIGS. **7**A and **7**B, which are respective top and side view simplified planar illustrations of the needle hub assembly of FIGS. **6**A and **6**B, to FIGS. **8**A and **8**B, which are sectional illustrations taken along respective section lines and directions VIIIA-VIIIA and VIIIB-VIIIB in FIGS. **7**A and **7**B and to FIGS. **9**A and **9**B, which are pictorial sectional illustrations taken along respective section lines and directions IXA-IXA and IXB-IXB in FIG. **6**A.

As seen in FIGS. **6**A-**9**B, the needle hub assembly **30** preferably comprises a needle hub **32**, which is an integrally formed element, preferably injection molded of plastic, and a needle **34**. Needle hub assembly **30** preferably has a generally cylindrical configuration and is preferably top-to-bottom and side-to-side symmetric about a longitudinal axis **300**, which, when assembled together with housing element **10**, is coaxial with longitudinal axis **100** (FIGS. **2**A-**5**B).

Needle hub assembly **30** preferably defines a generally tubular body **310**. A pair of up-down mutually spaced, forwardly facing, outwardly extending hook protrusions **312** and **314** is formed on each side of tubular portion **310**. Protrusions **312** and **314** are each associated with a rearward facing rib, here designated **316** and **318** respectively.

A rearwardly extending arm **320** is formed at both the top and the bottom of tubular body **310**. Each arm includes, adjacent an extreme rearwardly facing end **322** thereof, a tapered inwardly facing tooth **324** and forwardly thereof an outwardly facing tooth **326**, having a transversely extending rearwardly facing surface **330**.

Top and bottom pairs of outwardly facing ribs **332** and **334** are preferably formed on tubular portion **310**, adjacent rearward facing ribs **316** and **318** respectively. Outwardly facing ribs **332** and **334** are operative to slidably locate needle hub assembly **30** within needle guard element **40**. Tubular body **310** defines a generally open back and a forward facing wall portion **340** adjacent in which is formed a recess **342**, which communicates with a narrow axial bore **344**, arranged to receive needle **34**, which extends therethrough and is held in place, preferably by an adhesive, which is located in recess **342**. A rearward facing external wall portion **350**, located at the rearward end of tubular body **310**, defines a spring seat for spring **20**, which is partially surrounded by rearward facing ends of ribs **316** and **318**.

Reference is now made to FIGS. **10**A and **10**B, which are simplified pictorial illustrations of a needle guard element **40** which forms part of the automatic needle device of FIG. **1**, to FIGS. **11**A and **11**B, which are respective top and side view simplified planar illustrations of the needle guard element of FIGS. **10**A and **10**B, to FIGS. **12**A and **12**B, which are sectional illustrations taken along respective section lines and directions XIIA-XIIA and XIIB-XIIB in FIGS. **11**A and **11**B and to FIGS. **13**A and **13**B which are pictorial sectional illustrations taken along respective section lines and directions XIIIA-XIIIA and XIIIB-XIIIB in FIG. **10**A.

As seen in FIGS. **10**A-**13**B, the needle guard element **40** preferably is an integrally formed element, preferably injection molded of plastic. Needle guard **40** preferably has a

generally cylindrical configuration and is preferably top-to-bottom and side-to-side symmetric about a longitudinal axis **400**, which, when assembled together with housing element **10** and needle hub assembly **30** is coaxial with longitudinal axis **100** (FIGS. **2**A-**5**B) and longitudinal axis **300** (FIGS. **6**A-**9**B).

Needle guard element **40** preferably defines a generally tubular body **410**. Four mutually circumferentially spaced, longitudinally extending, outward facing ribs **412** and **414**, having rearward facing ends **413** and **415** respectively, are formed on both the top and the bottom of generally tubular body **410**. Outward facing ribs **412** and **414** are adapted to slidably locate the needle guard element **40** within the inwardly extending longitudinal slots **130** of the housing element **10**. Extending rearwardly of ribs **412** is a curved rearward facing portion **416** having a pair of ribs **417** formed therein, and extending rearwardly of ribs **414** is a similar and symmetrically curved rearward facing portion **418** having a pair of ribs **419** formed therein.

Curved rearward facing portions **416** and **418** together with rearward facing ends **413** and **415** define the seat for spring **22**. Ribs **417** and **419** are operative to slidably locate needle hub assembly **30** within needle guard element **40**, by allowing outwardly facing ribs **332** and **334** to slide therein. A rearwardly extending arm **420** is formed at each side of tubular body **410**. Each arm includes adjacent an extreme rearwardly facing end **422** thereof, an outwardly facing tooth **426**, having an inclined forward surface **428** and a transversely extending rearwardly facing surface **430**.

Tubular body **410** defines a generally open back and a forward facing wall portion **440**, defining an injection site engagement surface characterized in that it has a pair of mutually concentric circles **442** and **444** of mutually spaced forwardly extending protrusions **446**. Forward facing wall portion **440** is formed with an axial bore **450**, arranged to allow needle **34** to extend therethrough.

Top and bottom windows **452** and **454** are defined between respective pairs of ribs **412** and **414**.

The needle guard element **40** may optionally be formed with a pair of side-to-side symmetric windows, to allow viewing of the tip of the needle **34**, for example when purging air bubbles from syringe **50**. Alternatively, needle guard element **40** may be formed of a transparent material.

Reference is now made to FIGS. **14**A, **14**B, **14**C and **14**D which when taken together form a simplified pictorial illustration of various stages of typical use of the automatic needle device of FIG. **1**. As seen in FIG. **14**A the automatic needle device of FIG. **1** is stored prior to use in a pre-use operative orientation, described hereinbelow with reference to FIGS. **15**-**17**B. When ready for use, the user attaches a syringe **502**, containing a drug and ready for injection, to the automatic needle device of FIG. **1**, by inserting a forward end **504** of the syringe **502** into generally tubular portion **110** of housing element **10**.

As shown in FIG. **14**B, the user may then pull on tab portion **64** of safety tab **60** (FIG. **1**), thereby disengaging the tubular portion **62** from the automatic needle device and allowing activation of the automatic needle device.

The user may subsequently actuate the automatic needle device by pushing it against an injection site as indicated in FIG. **14**B and as described hereinbelow with reference to FIGS. **18**-**20**B. In response to user actuation, automatic needle penetration takes place at the injection site, as indicated in FIG. **14**C. Immediately thereafter drug delivery takes place, by user depression of a plunger in syringe **502**. The operative orientation of the automatic needle device at this stage is described hereinbelow with reference to FIGS. **21**-**23**B.

The operative orientation of the automatic needle device immediately following completion of drug delivery and disengagement of the automatic needle from the injection site is indicated in FIG. **14**D and is described hereinbelow with reference to FIGS. **24**-**26**B.

Reference is now made to FIGS. **15**A and **15**B, which are simplified assembled view illustrations of the automatic needle device of FIGS. **1** and **14**A in a pre-use operative orientation, to FIGS. **16**A and **16**B, which are respective top and side view simplified planar illustrations thereof and to FIGS. **17**A and **17**B, which are sectional illustrations taken along respective section lines and directions XVIIA-XVIIA and XVIIB-XVIIB in FIGS. **16**A and **16**B.

As seen in FIGS. **15**-**17**B, in a pre-use operative orientation of the automatic needle device, suitable for storage, the housing element **10** is joined to the needle hub assembly **30** by engagement of inner facing teeth **324** into apertures **144** formed in the cylindrical walls of bore **136**. First and second compression springs **20** and **22** are located mutually coaxially within housing element **10**.

Compression spring **20** is maintained under compression between forward-facing back wall surface **155** of generally cylindrical portion **118** of housing element **10** and rearward facing wall portion **350** of hub assembly **30**.

Compression spring **22** is maintained under compression between forward facing back wall surface **154** and rearward facing ends **413** and **415** of needle guard element **40**, which is slidably retained against forward movement by the positioning of curved rearward facing portions **416** and **418** thereof immediately rearward of teeth **326** of needle hub assembly **30**.

The needle hub assembly **30** is retained in place by engagement of outwardly facing surfaces of inner facing teeth **324** of rearwardly extending arms **320** and curved rearward facing portions **416** and **418** of needle guard element **40**. This prevents rearwardly extending arms **320** of needle hub assembly **30** from bending outwardly and releasing the engagement of inner facing teeth **324** and apertures **144** formed in the cylindrical walls of bore **136** of the housing **10**. The tubular portion **62** of safety tab **60** prevents the needle guard element **40** from moving backwards and allowing needle penetration.

Reference is now made to FIG. **18**, which is a simplified pictorial illustration of the automatic needle device of FIGS. **1** and **14**B after coupling to a syringe **502** in an injection site engagement operative orientation, to FIGS. **19**A and **19**B, which are respective top and side view simplified planar illustrations thereof and to FIGS. **20**A and **20**B, which are sectional illustrations taken along respective section lines and directions XXA-XXA and XXB-XXB in FIGS. **19**A and **19**B.

As seen particularly in FIG. **20**A, due to engagement of the needle guard element **40** with an injection site on a body, the needle guard **40** is forced, against the urging of spring **22**, to move axially in a rearward direction with respect to the remainder of the automatic needle device, thus sliding curved rearward facing portions **416** and **418** thereof further rearward of teeth **326** of needle hub assembly **30**.

This rearward repositioning of curved rearward facing portions **416** and **418** and the pressure of spring **20**, allow arms **320** of needle hub assembly **30** to cantilever outwardly.

Reference is now made to FIG. **21**, which is a simplified pictorial illustration of the automatic needle device of FIGS. **1** and **14**C in an actuated operative orientation, to FIGS. **22**A and **22**B which are respective top and side view simplified

planar illustrations thereof and to FIGS. **23**A and **23**B which are sectional illustrations taken along respective section lines and directions XXIIIA-XXIIIA and XXIIIB-XXIIIB in FIGS. **22**A and **22**B.

As seen particularly in FIG. **23**A, under the urging of spring **20**, inner facing teeth **324** slide out of apertures **144** formed in the cylindrical walls of bore **136**, thus allowing the needle hub assembly **30** to move axially forward and to provide needle penetration. The forward motion of needle hub assembly **30** stops when protrusions **312** and **314** come into touching engagement with inwardly extending transverse ribs **126** of the housing **10**. At this stage, drug delivery may take place in response to manual operation of syringe **502**

It is appreciated that at all times needle **34** sealingly and slidably engages septum **36**.

Reference is now made to FIG. **24**, which is a simplified pictorial illustration of the automatic needle device of FIGS. **1** and **14**D in a post-drug delivery, needle guarded operative orientation, to FIGS. **25**A and **25**B, which are respective top and side view simplified planar illustrations thereof and to FIGS. **26**A and **26**B, which are sectional illustrations taken along respective section lines and directions XXVIA-XXVIA and XXVIB-XXVIB in FIGS. **25**A and **25**B.

FIGS. **24-26**B illustrate the automatic needle device fully disengaged from the injection site and the needle guard **40** is fully extended under the urging of spring **22** to fully enclose the needle **34**. The needle guard **40** is prevented from moving farther forwards by engagement of curved rearward facing portions **416** and **418** and rearwardly extending surface **330** of teeth **326** of needle hub assembly **30**. The needle hub assembly **30** is prevented from moving further forward by protrusions **312** and **314** leaning against inwardly extending transverse ribs **126** of the housing **10**. The needle guard **40** is prevented from moving rearwardly by outwardly facing tooth **426**, which fits in front of inwardly extending transverse ribs **126** of the housing **10**. Therefore, at this stage the needle guard **40** is locked in place, protecting keeping the needle **34** from inadvertent engagement.

It is appreciated that the automatic needle device can be attached to various types of injection devices, and that the a luer adapter defined by an internal tapered surface of the tubular portion **110** of the housing element **10** of the automatic needle device may be readily modified for engagement with various injection devices such as pen injectors. It is also possible to integrate the automatic needle apparatus described herein into another injection device and thus to eliminate the need for a luer adapter.

Reference is now made to FIGS. **27-43**C, which illustrate the constituent elements of an automatic needle device constructed and operative in accordance with another preferred embodiment of the present invention.

As seen with particular clarity in FIG. **27**, the automatic needle device comprises a housing element **810**, having an integrally formed safety tab **812**, including a tab portion **814** and a spacer portion **816**, a resilient element **820**, which provides selectable forward displacement to a needle hub assembly **830**, which includes a hub portion **832** and a needle **834** adhesively or otherwise adhered thereto and extending rearwardly through a septum portion of resilient element **820**, and to a needle guard element **840**.

It is appreciated that safety tab **812** can be a separate part formed of any suitable material, for example such as polypropylene, and may formed in various configurations, such as a portion which is inserted into a slot between the needle guard element **840** and the housing element **810**, as a stand alone injection molded part, or as an integral part of any of the parts of the automatic needle device such as the housing element **810**, the needle guard element **840** or the needle hub **832**.

It will additionally be appreciated by those skilled in the art that resilient element **820** may be replaced with compression springs as described hereinabove with reference to FIGS. **1-26**B. Alternatively, compression springs **20** and **22** may be replaced by tension springs, elastomeric compression springs or plastic springs which are preferably integrated into housing element **810**, into needle hub assembly **830** or into needle guard element **840**.

Reference is now made to FIGS. **28**A and **28**B, which are simplified pictorial illustrations of a preferred housing element **810** which forms part of the automatic needle device of FIG. **27**, to FIGS. **29**A and **29**B which are simplified pictorial sectional illustrations of the housing element of FIGS. **28**A and **28**B taken along lines XXIXA-XXIXA and XXIXB-XXIXB in FIG. **28**A, to FIGS. **30**A and **30**B which are respective top and side view simplified planar illustrations thereof and to FIGS. **31**A, **31**B and **31**C which are sectional illustrations taken along respective section lines and directions XXXIA-XXXIA, XXXIB-XXXIB and XXXIC-XXXIC in FIGS. **30**A and **30**B.

As seen in FIGS. **28**A-**31**C, the housing element **810** preferably is an integrally formed element, preferably injection molded of plastic. Housing element **810** preferably has a generally cylindrical configuration and is preferably side-to-side symmetric about a longitudinal axis **900**.

Housing element **810** preferably includes a rearward generally tubular portion **910**, which terminates in an open back and defines generally symmetric side-facing tabs **914**. Forward of rearward generally tubular portion **910** there is provided a flange **916** onto which is removably mounted safety tab **812** (FIG. **27**) which, as will be described hereinbelow, when intact, prevents the needle guard **840** from rearward displacement into engagement with flange **916**.

Forward of flange **916** there are provided a pair of side-to-side symmetric generally axially directed, radially extending ribs **920**, each of which is formed with a rearward facing shoulder **926**. Also extending forwardly of flange **916** there is provided a generally axially directed rib **930**, which includes a narrow, generally axially directed, radially extending portion **932** forward of which a generally planar portion **934** is formed generally perpendicular to an underlying generally radially extending portion **936**. The generally planar portion **934** includes a radially inwardly tapered rearward facing surface **938** and a generally radial forward facing surface **940**.

Forwardly of surface **940**, rib **930** includes a further narrow not fully axially directed, radially extending portion **942** followed by a generally axially directed, radially extending portion **944**, having a rearward facing surface **946**. A socket **948** is formed between forward facing surface **940** of planar portion **934** and rearward facing surface **946** of portion **944**.

Interiorly of ribs **920** and **930** there is provided a forwardly tapered passageway **950** which terminates in a generally circular septum receiving socket **954** having a plurality of circumferentially distributed apertures **956**.

Reference is now made to FIGS. **32**A and **32**B, which are simplified pictorial illustrations of a resilient element which forms part of the automatic needle device of FIG. **27**, to FIGS. **33**A and **33**B which are simplified pictorial sectional illustrations of the resilient element of FIGS. **32**A and **32**B taken along lines XXXIIIA-XXXIIIA and XXXIIIB-XXXIIIB in FIG. **32**A, to FIGS. **34**A and **34**B which are respective top and side view simplified planar illustrations of the resilient element of FIGS. **32**A-**33**B and to FIGS. **35**A and **35**B which are

sectional illustrations taken along respective section lines and directions XXXVA-XXXVA and XXXVB-XXXVB in FIGS. **34**A and **34**B.

As seen in FIGS. **32**A-**35**B, the resilient element **820** is an integrally formed element, preferably injection molded or compression molded of rubber or plastic and preferably has a generally cylindrical configuration and is preferably top-to-bottom and side-to-side symmetric about a longitudinal axis **1000**, which, when assembled together with housing element **810**, is coaxial with longitudinal axis **900** (FIGS. **28**A-**31**C).

The resilient element preferably includes a generally cylindrical central portion **1010**, having a rear-facing wall **1012** formed with a tapered peripheral edge **1014** followed by a peripheral protrusion **1016** having a rounded cross section. Forward of protrusion **1016** is a generally cylindrical portion **1018** having four, circumferentially distributed, radially extending teeth **1020**, each of which has a forwardly radially outwardly inclined surface **1022** terminating in a forward facing surface **1024** which lies in a plane which is generally perpendicular to longitudinal axis **1000**.

Forward of cylindrical portion **1018** is a forward facing flange **1030** having radially outward extending protrusions **1032** at four corners thereof, separated from each other by 90 degrees. Extending rearwardly and radially outwardly from each protrusion **1032** are tensioned arms **1033**, **1034**, **1035** and **1036**, each of which terminates in a generally rectangular end portion **1037** having tapered outer edges **1038** and formed with a generally rectangular aperture **1040**. Tensioned arms **1033** and **1034** are slightly shorter than tensioned arms **1035** and **1036**.

Reference is now made to FIGS. **36**A and **36**B, which are simplified pictorial illustrations of a needle hub assembly which forms part of the automatic needle device of FIG. **27**, to FIGS. **37**A and **37**B which are simplified pictorial sectional illustrations of the needle hub assembly of FIGS. **36**A and **36**B taken along lines XXXVIIA-XXXVIIA and XXXVIIB-XXXVIIB in FIG. **36**A, to FIGS. **38**A and **38**B which are respective top and side view simplified planar illustrations of the needle hub assembly of FIGS. **36**A-**37**B and to FIGS. **39**A and **39**B are sectional illustrations taken along respective section lines and directions XXXIXA-XXXIXA and XXXIXB-XXXIXB in FIGS. **38**A and **38**B.

As seen in FIGS. **36**A-**39**B, the needle hub assembly **830** preferably comprises a needle hub **832** which is an integrally formed element, preferably injection molded of plastic and a needle **834**. Needle hub assembly **830** preferably has a generally cylindrical configuration and is preferably top-to-bottom and side-to-side mirror image symmetric about a longitudinal axis **1100**, which, when assembled together with housing element **810**, is coaxial with longitudinal axes **900** (FIGS. **28**A-**31**C) and **1000** (FIGS. **32**A-**35**B).

Needle hub assembly **830** preferably defines a generally tubular body **1110**. A rearwardly extending arm **1120** extends axially at both the top and the bottom of tubular portion **1110** and terminates in aright angle finger **1122**.

Tubular body **1110** defines a generally open back and a forward facing wall portion **1140** adjacent in which is formed a recess **1142**, which communicates with a narrow axial bore **1144**, arranged to receive needle **834**, which extends therethrough and is held in place, preferably by an adhesive, which is located in recess **1142**. Alternatively, needle hub portion **832** may be molded directly onto the needle.

A pair of arms **1150** having a cross-section in the shape of a C, extend generally axially rearwardly of tubular body **1110** and are each formed with a longitudinal slot **1154**, ending in a rear surface **1156**. Extending circumferentially from each arm **1150** is a wall portion **1160** at a rearward end of which extends a rearward-facing finger **1162**.

Reference is now made to FIGS. **40**A and **40**B which are simplified pictorial illustrations of a needle guard element which forms part of the automatic needle device of FIG. **27**, to FIGS. **41**A and **41**B which are simplified pictorial illustrations of the needle guard element of FIGS. **40**A and **40**B taken along the lines XLIA-XLIA and XLIB-XLIB in FIG. **40**A, to FIGS. **42**A and **42**B which are respective top and side view simplified planar illustrations of the needle guard element of FIGS. **40**A-**41**B and to FIGS. **43**A, **43**B and **43**C which are sectional illustrations taken along respective section lines and directions XLIIIA-XLIIIA, XLIIIB-XLIIIB and XLIIIC-XLIIIC in FIGS. **42**A and **42**B.

As seen in FIGS. **40**A-**43**C, the needle guard element **840** preferably is an integrally formed element, preferably injection molded of plastic. Needle guard **840** preferably has a generally cylindrical configuration and is preferably top-to-bottom and side-to-side symmetric about a longitudinal axis **1200**, which, when assembled together with housing element **810**, resilient element **820** and needle hub **830** is coaxial with longitudinal axis **900** (FIGS. **28**A-**31**C), longitudinal axis **1000** (FIGS. **32**A-**35**B) and longitudinal axis **1100** (FIGS. **36**A-**39**B).

Needle guard element **840** preferably defines a generally tubular body **1210**. A plurality of mutually circumferentially spaced, longitudinally extending, outward facing ribs **1212** are formed on a forward outer surface **1214** of generally tubular body **1210**. Extending rearwardly of ribs **1212** is a generally cylindrical portion **1216** having a pair of oppositely inward facing axial ribs **1220** and a rearward-facing notch **1224** at the top thereof. Forward of cylindrical portion **1216** and generally in line with notch **1224** there is formed in forward outer surface **1214** a socket **1228** and a bifurcated socket **1229**. The notch formed between socket **1228** and bifurcated socket **1229** defines an inclined surface **1230**.

Formed on an inner cylindrical surface **1231** of generally tubular body **1210** are a pair of longitudinally extending inner facing ribs **1232** which each terminate in a rearward facing finger **1234** located just forward of generally cylindrical portion **1216**. Also formed on inner cylindrical surface **1231** are a pair of longitudinally extending inner facing ribs **1236** which are intersected by sockets **1228** and **1229**.

Tubular body **1210** defines a generally open back and a forward facing wall portion **1240**, defining an injection site engagement surface characterized in that it has a peripheral array of mutually spaced forwardly extending protrusions **1246**. Forward facing wall portion **1240** is formed with an axial bore **1250**, arranged to allow needle **834** to extend therethrough.

The needle guard element **840** may optionally be formed a pair of side-to-side symmetric windows, to allow viewing of the tip of the needle **834**, for example when purging air bubbles from a syringe. Alternatively, needle guard element **840** may be formed of a transparent material.

Reference is now made to FIGS. **44**A, **44**B, **44**C, **44**D, **44**E and **44**F which are pictorial illustrations of various stages in typical use of the automatic needle device of FIG. **27**. The automatic needle device of FIG. **27** is stored prior to use in a pre-use operative orientation.

As shown in FIG. **44**A, the user may attach a syringe **1302** to the automatic needle device of FIG. **27**, by inserting a forward end **1304** of the syringe into generally tubular portion **910** of housing element **810**. A plunger **1306** is inserted in syringe **1302**. The operative orientation of the automatic needle device at this stage is described hereinbelow with reference to FIGS. **45**-**47**D.

The user then actuates the automatic needle device by removing safety tab **812** and pushing the needle device against an injection site, as shown in FIG. **44**B and as described hereinbelow with reference to FIGS. **48-50**D. In response to user actuation, needle penetration takes place at the needle site, as shown in FIG. **44**C. The operative orientation of the automatic needle device at this stage is described hereinbelow with reference to FIGS. **51-53**D.

Immediately following needle penetration, drug delivery takes place by the user pushing plunger **1303** of syringe **1302** inward. The operative orientation of the automatic needle device immediately following completion of drug delivery is shown in FIG. **44**D and is described hereinbelow with reference to FIGS. **54-56**D.

As seen in FIG. **44**E, the automatic needle device is then manually disengaged from the injection site. The operative orientation of the automatic injection device at this stage is described hereinbelow with reference to FIGS. **57-59**D. Immediately upon disengagement, the needle is protected by the needle guard element **840**.

Should the needle guard be forced axially rearward as shown in FIG. **44**F, its rearward movement produces corresponding rearward motion of the needle hub assembly **830**. The operative orientation of the automatic needle device in this case is described hereinbelow with reference to FIGS. **60-62**D.

Reference is now made to FIG. **45**, which is a simplified assembled view illustration of the automatic needle device of FIGS. **27** and **44**A in a pre-use operative orientation coupled to a syringe and prior to removal of a safety tab, to FIGS. **46**A and **46**B, which are respective top and side view simplified planar illustrations thereof, to FIGS. **47**A and **47**B, which are sectional illustrations taken along respective section lines and directions XLVIIA-XLVIIA and XLVIIB-XLVIIB in FIGS. **46**A and **46**B, to FIG. **47**C which is a simplified illustration corresponding to FIG. **46**A with the needle guard hidden and to FIG. **47**D which is a simplified partially cut-away illustration of the needle guard element **840** and the needle hub assembly **830** of FIG. **46**B.

As seen in FIGS. **45-47**D, in a pre-use operative orientation of the automatic needle device, the needle hub assembly **830** is urged forwardly along axis **900** relative to housing element **810** by tensioned arms **1033** and **1034** of resilient element **820**. End portions **1037** of arms **1033** and **1034** engage corresponding rearward facing fingers **1162** of needle hub assembly **830**, while the cylindrical portion **1010** of the resilient element **820** is retained in socket **954** formed in housing element **810**.

The housing element **810** retains the needle hub assembly **830** against axial forward displacement relative to housing element **810** by engagement of rearward facing shoulders **926** of ribs **920** of housing element **810** with corresponding rear surfaces **1156** of longitudinal slots **1154** formed in arms **1150** of needle hub assembly **830**.

In the pre-use operative orientation of the automatic needle device, the needle guard element **840** is urged forwardly along axis **900** relative to housing element **810** by tensioned arms **1035** and **1036** of resilient element **820**. End portions **1037** of arms **1035** and **1036** engage corresponding rearward facing fingers **1234** formed on inner cylindrical surface **1231** of generally tubular body **1210** of the needle guard element **840**, while the cylindrical portion **1010** of the resilient element **820** is retained in socket **954** formed in housing element **810**.

The needle hub assembly **830** retains the needle guard element **840** against axial forward displacement relative to housing element **810** by engagement of right angle fingers **1122** of needle hub assembly **830** with bifurcated sockets **1229** formed in needle guard element **840**.

Safety tab **812** mounted on flange **916** of housing element **810** prevents rearward axial displacement of needle guard element **840** relative to housing element **810**.

Reference is now made to FIG. **48**, which is a simplified pictorial illustration of the automatic needle device of FIGS. **27** and **44**B in an injection site engagement operative orientation following removal of the safety tab **812** from housing element **810**, to FIGS. **49**A and **49**B, which are respective top and side view simplified planar illustrations thereof, to FIGS. **50**A and **50**B which are sectional illustrations taken along respective section lines and directions LA-LA and LB-LB in FIGS. **49**A and **49**B, to FIG. **50**C which is a simplified illustration corresponding to FIG. **49**A with the needle guard hidden and to FIG. **50**D which is a simplified partially cut-away illustration of the needle guard element **840** and the needle hub assembly **830** of FIG. **49**B.

As seen particularly in FIG. **50**A, due to engagement of the needle guard element **840** with an injection site on a body, the needle guard **840** is forced, against the urging of tensioned arms **1035** and **1036**, to move axially in a rearward direction with respect to the housing element **810**. This displacement stretches tensioned arms **1035** and **1036**.

This rearward repositioning of needle guard element **840** produces an identical rearward displacement of needle hub assembly **830**, against the urging of tensioned arms **1033** and **1034**, by virtue of engagement of right angle fingers **1122** of needle hub assembly **830** with bifurcated sockets **1229** formed in needle guard element **840**. This displacement stretches tensioned arms **1033** and **1034**.

The rearward displacement of the needle hub assembly **830** causes the needle **834** to be displaced rearwardly by an identical amount with respect to cylindrical portion **1018** of resilient element **820**.

Reference is now made to FIG. **51**, which is a simplified pictorial illustration of the automatic needle device of FIGS. **27** and **44**C in a needle actuated operative orientation, to FIGS. **52**A and **52**B which are respective top and side view simplified planar illustrations thereof, to FIGS. **53**A and **53**B which are sectional illustrations taken along respective section lines and directions LIIIA-LIIIA and LIIIB-LIIIB in FIGS. **52**A and **52**B, to FIG. **53**C which is a simplified illustration corresponding to FIG. **52**A with the needle guard hidden and to FIG. **53**D which is a simplified partially cut-away illustration of the needle guard element **840** and the needle hub assembly **830** of FIG. **52**B.

As seen particularly in FIG. **53**A, due to rearward displacement of the needle guard element **840** and of the needle hub assembly **830** relative to the housing element **810** and specifically relative to planar portion **934** thereof, the right angle fingers **1122** are now free to be cantilevered inwardly by sliding along rearward facing inclined surfaces **1230** and to slide forwardly along tapered rearward facing surfaces **938** thereof and along inner facing surfaces of planar portions **934**, thus permitting axial forward motion of the needle hub assembly **830** under the urging of tensioned arms **1033** and **1034**, which become less stretched as a result.

The forward displacement of the needle hub assembly **830** causes the needle **834** to be displaced forwardly with respect to cylindrical portion **1018** of resilient element **820**.

The forward axial motion of the needle hub assembly **830** produces needle penetration at the injection site.

Reference is now made to FIG. **54**, which is a simplified pictorial illustration of the automatic needle device of FIGS. **27** and **44**D in a full needle penetration and an immediately post drug delivery operative orientation, to FIGS. **55**A and

55B, which are respective top and side view simplified planar illustrations thereof, to FIGS. 56A and 56B, which are sectional illustrations taken along respective section lines and directions LVIA-LVIA and LVIB-LVIB in FIGS. 55A and 55B, to FIG. 56C which is a simplified illustration corresponding to FIG. 55A with the needle guard hidden and to FIG. 56D which is a simplified partially cut-away illustration of the needle guard element 840 and the needle hub assembly 830 of FIG. 55B.

It is seen that the needle hub assembly 830 is a forward axial position, at which right angle fingers 1122 are seated in respective sockets 948, thus locking the needle hub assembly 830 to housing element 810. In this position, the right angle fingers 1122 are bent circumferentially and radially inward and are retained in this orientation by engagement with respective ribs 1236 formed on inner cylindrical surface 1231 of needle guard element 840. The further axial forward motion of the needle hub assembly 830 under the urging of tensioned arms 1033 and 1034 causes arms 1033 and 1034 to be even less stretched.

Full needle penetration is provided at this stage and a user normally injects a drug into the injection site by depressing plunger 1306 of syringe 1302.

Reference is now made to FIG. 57 which is a simplified pictorial illustration of the automatic needle device of FIGS. 27 and 14E in a post-drug delivery, needle guarded operative orientation, to FIGS. 58A and 58B, which are respective top and side view simplified planar illustrations of the automatic needle device of FIG. 57, to FIGS. 59A and 59B which are sectional illustrations taken along respective section lines and directions LIXA-LIXA and LIXB-LIXB in FIGS. 58A and 58B, to FIG. 59C which is a simplified illustration corresponding to FIG. 58A with the needle guard hidden and to FIG. 59D which is a simplified partially cut-away illustration of the needle guard element 840 and the needle hub assembly 830 of FIG. 58B.

FIGS. 57-59D illustrate the automatic needle device fully disengaged from the needle site and the needle guard element 840 fully extended under the urging of tensioned arms 1035 and 1036 to fully enclose the needle 834. The needle guard 840 is prevented from moving further forward by engagement of right angle fingers 1122 of needle hub assembly 830 in respective sockets 1128 formed in needle guard element 840 and by engagement of rearward facing shoulders 926 of ribs 920 of housing element 810 with corresponding rear surfaces 1156 of longitudinal slots 1154 formed in arms 1150 of needle hub assembly 830.

Reference is now made to FIG. 60 which is a simplified pictorial illustration of the automatic needle device of FIGS. 27 and 44F in a needle guard pushed back misuse operative orientation, to FIGS. 61A and 61B which are respective top and side view simplified planar illustrations of the automatic needle device of FIG. 60, to FIGS. 62A and 62B are sectional illustrations taken along respective section lines and directions LXIIA-LXIIA and LXIIB-LXIIB in FIGS. 61A and 61B, to FIG. 62C which is a simplified illustration corresponding to FIG. 61A with the needle guard hidden and to FIG. 62D which is a simplified partially cut-away illustration of the needle guard element 840 and the needle hub assembly 830 of FIG. 61B.

FIGS. 60-62D illustrate an important feature of the present invention provided by engagement of right angle fingers 1122 of needle hub assembly 830 in respective sockets 1128 formed in needle guard 840. Should the needle guard 840 be pushed rearwardly with respect to housing element 810, needle hub assembly 830 and needle 834 move axially rearwardly together with needle guard element, so that the needle 834 does not protrude from the needle guard 840. It is appreciated that the automatic needle device can be attached to various types of injection devices, and that the a luer adapter defined by an internal tapered surface of the tubular portion 110 of the housing element 10 of the automatic needle device may be readily modified for engagement with various injection devices such as pen injectors. It is also possible to integrate the automatic needle apparatus described herein into another injection device and thus to eliminate the need for a luer adapter.

Reference is now made to FIGS. 63-75B, which illustrate an automatic needle device constructed and operative in accordance with yet another preferred embodiment of the present invention. The embodiment of FIGS. 63-75B is a modification of the embodiment of FIGS. 1-26B. Accordingly, for the sake of conciseness, it is described in somewhat abbreviated form hereinbelow:

As seen with particular clarity in FIG. 63, the automatic needle device comprises a housing element 1510 into which are generally coaxially seated respective first and second compression springs 1520 and 1522, which provide selectable forward displacement to a needle hub assembly 1530, which includes a hub portion 1532 and a needle 1534 adhesively adhered thereto and rearwardly coupled to a forward end of an elastic tube 1536, whose rearward end is coupled to a liquid passage passageway formed in housing element 1510, and to a needle guard element 1540. Alternatively, needle hub portion 1532 may be injected onto the needle, by a method such as insert molding.

A safety tab 1560 is preferably mounted onto the forward section of housing element 1510, thus disabling actuation of the automatic needle device. The automatic needle device is only functional once the safety tab is removed, as described hereinbelow.

It will be appreciated that safety tab 1560 can be formed of any suitable material for example such as polypropylene, and may be formed in various configurations, such as a portion which is inserted into a slot between the needle guard element 1540 and the housing element 1510, as a stand alone injection molded part, or as an integral part of any of the parts of the automatic needle device such as the housing element 1510 as described hereinabove with reference to FIGS. 27-62D, the needle guard element 1540 or the needle hub assembly 1530.

It will additionally be appreciated by those skilled in the art that compression springs 1520 and 1522 may be replaced with a resilient element as described hereinabove with reference to FIGS. 27-62D. Alternatively, compression springs 1520 and 1522 may be replaced by tension springs, elastomeric compression springs or plastic springs which are preferably integrated into housing element 1510, into needle hub assembly 1530 or into needle guard element 1540.

Reference is now made to FIGS. 2A and 2B, which are simplified pictorial illustrations of a preferred housing element 10 which forms part of the automatic needle device of FIG. 1, to FIGS. 3A and 3B are respective top and side view simplified planar illustrations thereof, to FIGS. 4A and 4B which are sectional illustrations taken along respective section lines and directions IVA-IVA and IVB-IVB in FIGS. 3A and 3B and to FIGS. 5A and 5B which are pictorial sectional illustrations taken along respective section lines and directions VA-VA and VB-VB in FIG. 2A.

Housing element 1510 is identical to the housing element 10 other than in the following respect, shown in FIG. 63:

Communicating with an interior of rearward generally tubular portion 1610 there is provided a narrow passageway 1652 which sealingly receives the rearward end of elastic tube 1536.

Reference is now made to FIGS. **6**A and **6**B, which are simplified pictorial illustrations of a needle hub assembly **30** which forms part of the automatic needle device of FIG. **1**, to FIGS. **7**A and **7**B, which are respective top and side view simplified planar illustrations of the needle hub assembly of FIGS. **6**A and **6**B, to FIGS. **8**A and **8**B, which are sectional illustrations taken along respective section lines and directions VIIIA-VIIIA and VIIIB-VIIIB in FIGS. **7**A and **7**B and to FIGS. **9**A and **9**B, which are pictorial sectional illustrations taken along respective section lines and directions IXA-IXA and IXB-IXB in FIG. **6**A.

Needle hub assembly **1530** is identical to needle hub assembly **30** shown in FIGS. **6**A-**9**B, except in that the needle **1534** is shorter than needle **34** in the embodiment of FIGS. **1**-**26**B, due to the provision of the elastic tube **1536**, the forward end of which is sealingly located in a narrow passageway **1654** provided in the needle hub assembly.

Reference is now made to FIGS. **10**A and **10**B, which are simplified pictorial illustrations of a needle guard element **40** which forms part of the automatic needle device of FIG. **1**, to FIGS. **11**A and **11**B, which are respective top and side view simplified planar illustrations of the needle guard element of FIGS. **10**A and **10**B, to FIGS. **12**A and **12**B, which are sectional illustrations taken along respective section lines and directions XIIA-XIIA and XIIB-XIIB in FIGS. **11**A and **11**B and to FIGS. **13**A and **13**B which are pictorial sectional illustrations taken along respective section lines and directions XIIIA-XIIIA and XIIIB-XIIIB in FIG. **10**A.

The needle guard element **1540** is identical to needle guard element **40** shown in FIGS. **10**A-**13**B.

Reference is now made to FIGS. **14**A, **14**B, **14**C and **14**D which when taken together form a simplified pictorial illustration of various stages of typical use of the automatic needle device of FIG. **1**. FIGS. **14**A-**14**D also illustrate the various stages of typical use of the automatic needle device of FIG. **63** and the above description of FIGS. **14**A-**14**D applies to the embodiment of FIGS. **63**-**75**B as well.

Reference is now made to FIGS. **64**A and **64**B, which are simplified assembled view illustrations of the automatic needle device of FIG. **63** in a pre-use operative orientation, to FIGS. **65**A and **65**B, which are respective top and side view simplified planar illustrations thereof and to FIGS. **66**A and **66**B, which are sectional illustrations taken along respective section lines and directions LXVIA-LXVIA and LXVIB-LXVIB in FIGS. **65**A and **65**B.

As seen in FIGS. **64**-**66**B, in a pre-use operative orientation of the automatic needle device, suitable for storage, the housing element **1510** is joined to the needle hub assembly **1530** by engagement of inner facing teeth **1824** into apertures **1644** formed in the cylindrical walls of bore **1636**. First and second compression springs **1520** and **1522** are located mutually coaxially within housing element **1510**. Compression spring **1520** is maintained under compression between forward-facing back wall surface **1655** of generally cylindrical portion **1618** of housing element **1510** and rearward facing wall portion **1850** of hub assembly **1530**. Compression spring **1522** is maintained under compression between forward facing back wall surface **1655** and rearward facing ends **1913** and **1915** of needle guard element **1540**, which is slidably retained against forward movement by the positioning of curved rearward facing portions **1916** and **1918** thereof immediately rearward of teeth **1826** of needle hub assembly **1530**.

The needle hub assembly **1530** is retained in its place by engagement of outwardly facing surface of inner facing teeth **1824** of rearwardly extending arm **1820** and curved rearward facing portions **1916** and **1918** of needle guard element **1540**, thus preventing rearwardly extending arms **1820** of needle hub assembly **1530** from bending outwards and releasing the engagement of inner facing teeth **1824** and apertures **1644** formed in the cylindrical walls of bore **1636** of the housing **1510**. The tubular portion **2104** of safety tab **1560** prevents the needle guard element **1540** from moving backwards and actuating needle penetration.

It is seen that the elastic tube **1536** is in a relatively compressed state and is coupled at a forward end thereof to narrow passageway **1654** provided in the needle hub assembly **1530** and is coupled at a rearward end thereof to narrow passageway **1652** formed in housing element **1510**.

Reference is now made to FIG. **67**, which is a simplified pictorial illustration of the automatic needle device of FIG. **63** after coupling thereto of a syringe **2002** in an injection site engagement operative orientation, to FIGS. **68**A and **68**B, which are respective top and side view simplified planar illustrations thereof and to FIGS. **69**A and **69**B, which are sectional illustrations taken along respective section lines and directions LXIXA-LXIXA and LXIXB-LXIXB in FIGS. **68**A and **68**B.

As seen particularly in FIG. **69**A, due to engagement of the needle guard element **1540** with an injection site on a body, the needle guard **1540** is forced, against the urging of spring **1522**, to move axially in a rearward direction with respect to the remainder of the automatic needle device, thus sliding curved rearward facing portions **1916** and **1918** thereof further rearward of teeth **1826** of needle hub assembly **1530**.

This rearward repositioning of curved rearward facing portions **1916** and **1918** and the pressure of spring **1520**, allow arms **1820** of needle hub assembly **1530** to cantilever outward.

It is seen that the elastic tube **1536** is in a relatively extended state.

Reference is now made to FIG. **70**, which is a simplified pictorial illustration of the automatic needle device of FIG. **63** in an actuated operative orientation, to FIGS. **71**A and **71**B which are respective top and side view simplified planar illustrations thereof and to FIGS. **72**A and **72**B which are sectional illustrations taken along respective section lines and directions LXXIIA-LXXIIA and LXXIIB-LXXIIB in FIGS. **71**A and **71**B.

As seen particularly in FIG. **72**A, under the urging of spring **1520**, inner facing teeth **1824** slide out of apertures **1644** formed in the cylindrical walls of bore **1636**, thus allowing the needle hub assembly **1530** to move axially forward and to provide needle penetration. The forward motion of needle hub assembly **1530** stops when protrusions **1812** and **1814** come into touching engagement with inwardly extending transverse ribs **1626** of the housing **1510**. At this stage, drug delivery may take place in response to manual operation of a syringe **2002**.

It is seen that the elastic tube **1536** is in a highly extended state.

Reference is now made to FIG. **73**, which is a simplified pictorial illustration of the automatic needle device of FIG. **63** in a post-drug delivery, needle guarded operative orientation, to FIGS. **74**A and **74**B, which are respective top and side view simplified planar illustrations thereof and to FIGS. **75**A and **75**B, which are sectional illustrations taken along respective section lines and directions LXXVA-LXXVA and LXXVB-LXXVB in FIGS. **74**A and **74**B.

FIGS. **73**-**75**B illustrate the automatic needle device fully disengaged from the injection site and the needle guard **1540** fully extended under the urging of spring **1522** to fully enclose the needle **1534**. The needle guard **1540** is prevented from moving farther forwards by engagement of curved rearward facing portions **1916** and **1918** and rearwardly extend-

ing surface **1830** of teeth **1826** of needle hub assembly **1530**. The needle hub assembly **1530** is prevented from moving further forward by protrusions **1812** and **1814** leaning against inwardly extending transverse ribs **1626** of the housing **1510**. The needle guard **1540** is prevented from moving rearwardly by outwardly facing tooth **1926** which snap-fits in front of inwardly extending transverse ribs **1626** of the housing **1510**. Therefore, at this stage the needle guard **1540** is locked in place keeping the needle protected. It is seen that the elastic tube **1536** remains in a highly extended state. It is appreciated that the automatic needle device can be attached to various types of injection devices, and that the a luer adapter defined by an internal tapered surface of the tubular portion **110** of the housing element **10** of the automatic needle device may be readily modified for engagement with various injection devices such as pen injectors. It is also possible to integrate the automatic needle apparatus described herein into another injection device and thus to eliminate the need for a luer adapter.

It will be appreciated by persons skilled in the art that the present invention is not limited to what has been particularly shown and described hereinabove. Rather the scope of the present invention includes both combinations and subcombinations of various features described hereinabove as well as modifications of such features which would occur to a person of ordinary skill in the art upon reading the foregoing description and which are not in the prior art.

The invention claimed is:

1. An automatic needle device comprising:

a housing element;

at least one resilient element arranged to be located within said housing element;

at least one needle bearing element adapted, when actuated, to be displaced by said at least one resilient element with respect to said housing element from a non-penetration position to a penetration position; and

a needle guard adapted for positioning with respect to said housing element and wherein displacement of said needle guard relative to said housing element operative to actuate displacement of said at least one needle bearing element from said non-penetration position to said penetration position.

2. An automatic needle device according to claim **1** and wherein rearward displacement of said needle guard is operative to actuate displacement of said at least one needle bearing element from said non-penetration position to said penetration position.

3. An automatic needle device according to claim **1** and also comprising a safety element adapted to prevent inadvertent actuation of displacement of said at least one needle bearing element.

4. An automatic needle device according to claim **3** and wherein said safety element prevents inadvertent rearward displacement of said needle guard.

5. An automatic needle device according to claim **1** and wherein said at least one resilient element comprises a unitary resilient element.

6. An automatic needle device according to claim **1** and wherein said at least one resilient element comprises first and second coil springs.

7. An automatic needle device according to claim **1** and wherein said housing element includes an injection device engagement portion.

8. An automatic needle device according to claim **7** and wherein said housing element and said at least one needle bearing element together define a fluid pathway from said injection device engagement portion through said needle at least when said needle bearing element is in both said non-penetration position and said penetration position.

9. An automatic needle device according to claim **1** and wherein said needle guard is displaceable by said at least one resilient element.

10. An automatic needle device according to claim **1** and wherein said at least one resilient element comprises first and second compression springs which provide selectable forward displacement to said at least one needle bearing element.

11. An automatic needle device according to claim **1** and wherein said needle bearing element includes a hub portion and a needle adhered thereto and extending through a septum.

12. An automatic needle device according to claim **1** and also comprising a safety tab operative for disabling actuation of the automatic needle device.

13. An automatic needle device according to claim **12** and wherein said safety tab includes a spacer portion and a tab portion.

14. An automatic needle device according to claim **1** and wherein said housing element is an integrally formed element having a generally cylindrical configuration and is generally top-to-bottom and side-to-side symmetric about a longitudinal axis.

15. An automatic needle device according to claim **1** and wherein said housing element includes a rearward generally tubular portion which terminates in an open back and defines forwardly thereof a generally cylindrical portion, whose outer configuration includes top and bottom grip regions.

16. An automatic needle device according to claim **1** and wherein said housing element includes first and second forwardly and rearwardly tapered side protrusions.

17. An automatic needle device according to claim **15** and comprising at an inner surface of said generally cylindrical portion forward and rearward inwardly extending transverse ribs and a plurality of inwardly extending longitudinal slots.

18. An automatic needle device according to claim **1** and wherein said housing element is formed with a pair of side-to-side symmetric windows, to allow viewing of the tip of a needle held by said needle bearing element.

19. An automatic needle device according to claim **1** and wherein said needle bearing element comprises a needle hub and a needle.

20. An automatic needle device according to claim **19** and wherein said needle bearing element has a generally cylindrical configuration and is top-to-bottom and side-to-side symmetric about a longitudinal axis.

21. An automatic needle device according to claim **19** and wherein said needle bearing element defines a generally tubular body having formed thereon a pair of up-down mutually spaced, forwardly facing, outwardly extending hook protrusions.

22. An automatic needle device according to claim **21** and wherein said protrusions are each associated with a rearward facing rib.

23. An automatic needle device according to claim **21** and wherein a rearwardly extending arm is formed at both a top and a bottom of said tubular body, each arm including, adjacent an extreme rearwardly facing end thereof, a tapered inwardly facing tooth and forwardly thereof an outwardly facing tooth, having a transversely extending rearwardly facing surface.

24. An automatic needle device according to claim **21** and wherein top and bottom pairs of outwardly facing ribs are formed on said tubular portion, adjacent respective rearward

facing ribs, said outwardly facing ribs being operative to slidably locate said needle bearing element within said needle guard.

25. An automatic needle device according to claim **21** and wherein said tubular body defines a generally open back and a forward facing wall portion adjacent in which is formed a recess, which communicates with a narrow axial bore, arranged to receive said needle, which extends therethrough.

26. An automatic needle device according to claim **21** and wherein a rearward facing external wall portion, located at a rearward end of said tubular body, defines a seat for said at least one resilient element.

27. An automatic needle device according to claim **1** and wherein said needle guard has a generally cylindrical configuration and is top-to-bottom and side-to-side symmetric about a longitudinal axis.

28. An automatic needle device according to claim **1** and wherein said needle guard defines a generally tubular body having formed thereon a plurality of circumferentially spaced, longitudinally extending, outward facing ribs, having rearward facing ends, said outward facing ribs being adapted to slidably locate said needle guard within inwardly extending longitudinal slots of said housing element.

29. An automatic needle device according to claim **28** and wherein extending rearwardly of said outwardly facing ribs there is provided a curved rearward facing portion having a pair of inwardly facing ribs formed therein, and, extending rearwardly of said ribs, there is formed a symmetrically curved rearward facing portion having a pair of ribs formed therein.

30. An automatic needle device according to claim **29** and wherein said curved rearward facing portions together with said rearward facing ends define a seat for a spring forming part of said at least one resilient element.

31. An automatic needle device according to claim **29** and wherein said inwardly facing ribs are operative to slidably locate said needle bearing element within said needle guard, by allowing said outwardly facing ribs to slide therein.

32. An automatic needle device according to claim **28** and wherein a rearwardly extending arm is formed at each side of said tubular body, each of said arms including adjacent an extreme rearwardly facing end thereof, an outwardly facing tooth, having an inclined forward surface and a transversely extending rearwardly facing surface.

33. An automatic needle device according to claim **28** and wherein said tubular body defines a generally open back and a forward facing wall portion, defining an injection site engagement surface.

34. An automatic needle device according to claim **33** and wherein said injection site engagement surface includes a pair of mutually concentric circles of mutually spaced forwardly extending protrusions and said forward facing wall portion is formed with an axial bore, arranged to allow a needle to extend therethrough.

35. An automatic needle device according to claim **1** and wherein said needle guard is formed with a pair of side-to-side symmetric windows, to allow viewing of the tip of a needle.

36. An automatic needle device according to claim **1** and wherein, in a pre-use operative orientation suitable for storage, said housing element is joined to said needle bearing element by snap fit engagement of inner facing teeth formed on said needle bearing element into apertures formed in cylindrical walls of said housing element.

37. An automatic needle device according to claim **36** and wherein said at least one resilient element comprises first and second compression springs, said first compression spring being maintained under compression between forward-facing back wall surface of a generally cylindrical portion of said housing element and a rearward facing wall portion of said needle bearing element and said second compression spring being maintained under compression between said forward facing back wall surface and rearward facing ends of said needle guard, which is slidably retained against disassembly forward movement by the positioning of curved rearward facing portions thereof immediately rearward of said inner facing teeth of said needle bearing element.

38. An automatic needle device according to claim **36** and wherein said needle bearing element is retained in its place by engagement of rearwardly outwardly facing surfaces of said inner facing teeth with curved rearward facing portions of said needle guard, thus preventing rearwardly extending arms of said needle bearing element from bending outwardly and releasing the snap fit engagement of said inner facing teeth and apertures formed in the cylindrical walls of said cylindrical bore of said housing element.

39. An automatic needle device according to claim **38** and wherein due to engagement of said needle guard with an injection site on a body, said needle guard is forced, against the urging of said at least one resilient element, to move axially in a rearward direction with respect to the remainder of the automatic needle device, thus sliding said curved rearward facing portions thereof further rearward of outwardly facing teeth of said needle bearing element, thus allowing said arms of said needle bearing element to cantilever outwardly.

40. An automatic needle device according to claim **36** and wherein at all times said needle sealingly and slidably engages a septum.

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